AAS
Asian & Asian American Studies

AAS 500: Intellectual History of East Asia
This course examines the major intellectual traditions of East Asia with an idea that intellectual movements not only reflect but also influence historical developments. It is designed to help students enhance their understanding of East Asian thoughts, history, and culture. Topics will cover the intellectual movements in China, Japan, and Korea from ancient times to the early 20th century.
3 credits, Letter graded (A, A-, B+, etc.)

AAS 501: Proseminar: Topics & Methods in Contemporary Asian and Asian American Studies
This course introduces students to qualitative and quantitative research methods commonly used in social sciences and humanities, including narrative research, phenomenological research, ethnographic research, case study research, correlational research, and survey research. Students are expected to identify a topic of interest of their own choosing within Contemporary Asian and Asian American Studies and develop a pilot research project. The instructor plays the role of a facilitator by leading methodological as well as thematic discussions on research topics initiated by students. This course takes the formats of lectures, workshops, student presentations, peer critique, and one-on-one instructor-student conferences.
3 credits, Letter graded (A, A-, B+, etc.)

AAS 505: The Pacific, Travel and Empire
This cultural studies course examines the cultures of travel (i.e. fiction, memoirs, photography, and filmmaking) in narratives by and about the Pacific, South and Southeast Asia. We will study the empires by analyzing narratives about the former colonies of Spain, France, Britain and the United States. As we discuss the metaphors or tropes of empire, we will also examine the concept of empire as a historical and contemporary formation, or what an empire meant in the 19th century and what is means today in the early 21st century. The course begins with the premise that travel narratives and modern visual culture illuminate the relationship between the violence and romance of travel. The course includes modern travel narratives (i.e. novels by Asian Americans) that focus on the lives of those who are forced to travel or migrate due to civil war, poverty and/or economic instability.
3 credits, Letter graded (A, A-, B+, etc.)

AAS 534: English in Asia
Study of the expanding roles of English in South Asia, East Asia, and Southeast Asia. With more non-native speakers than native speakers, and more in Asia than elsewhere, English has acquired new identities. We will study functions of English in colonial and post-colonial times; how it competes with, and complements local languages in business, advertising, media, education, research, administration, judiciary, creative literature, call centers, and on the Internet; the evolution of dynamic new Asian Englishes, such as Indian English, and their social and cultural contexts; controversies regarding English medium education and its impact on local languages, relevance of native English standards, and implications for theory, description, and method in diverse disciplines, such as business communication, cultural studies, English, lexicography, speech recognition, journalism, media studies, sociolinguistics, teaching English as a second language, and Asian Studies.
3 credits, Letter graded (A, A-, B+, etc.)

AAS 540: Inter-Asia Cultural Studies
This course is an examination of the critical theory on Inter-Asia cultures and phenomena. Emphasis is placed on the role of culture within the writing, documentation, and evidencing of history. Attention may be focused on a particular era, group, institution, type of object, or event.
3 credits, Letter graded (A, A-, B+, etc.)

AAS 545: Learning of Asian Languages
This course will analyze the cognitive processes involved in the acquisition of Asian languages as second or foreign languages. We will start with discussion of first language acquisition and compare it with second language acquisition (SLA). Methodologies such as contrastive analysis and error analysis, and concepts such as interlanguage, native and non-native competence, bilingual competence, acceptability, correctness, standard language will be critically examined. We will also consider the variables that affect SLA, including age, context, exposure, attitude, cognition, attention and motivation. Special attention will be given to the applicability of current research paradigms and findings to the acquisition of languages such as Chinese, Japanese, Korean, and Hindi, both in terms of their structural characteristics and in their socio-cultural context.
3 credits, Letter graded (A, A-, B+, etc.)

AAS 547: Directed Reading in Contemporary Asian and Asian American Studies
This course provides an opportunity for graduate students in Contemporary Asian and Asian American Studies to pursue readings in an area of their interest as part of their graduate program studies. Independent readings in graduate topics in Contemporary Asian and Asian American studies. May be repeated. Prerequisites: Approval by Director of Graduate Studies
1-6 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

AAS 555: Heritage Languages of Asian Americans
English has long been the dominant language used in the United States, while the languages of numerous indigenous and immigrant communities have declined and many have died. At the same time, the United States' extensive global role, the rising geopolitical rise of Asian powers, such as China, India, Japan, South Korean, and others has highlighted the need to foster greater Asian language and cultural skills among Americans. In that context, maintaining the existing diversity of languages spoken among American immigrant populations becomes as important and effective as teaching the languages to new populations. There is an increasing recognition that the advantages of such multilingualism are not only cultural, but also cognitive, diplomatic, security, commercial, social, and political as well. Retaining knowledge of the home language is found to promote the minority individuals' psychological well-being, facilitate communication and bonding across generations, and ease the process of adjusting to life away from the home country, while promoting a pluralistic outlook and providing globally valuable job skills. Still, the brunt of the actual effort to foster multilingualism has been left to individual families despite the known fact that parental effort at maintenance alone are not enough to prevent an eventual shift to English. This new course is a critical examination of the nature and extent of available support (institutional, social, family, and other) for maintaining this valuable resource of Asian immigrants languages. Students learn through through in-depth readings, class lectures and discussions, and directed research in language communities of their choice.
3 credits, Letter graded (A, A-, B+, etc.)

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AAS 560: Empire, Memory and Narratives of Asian America
Asian American literary scholars have focused on the tropes of immigration and settlement as major paradigms for mapping the landscape of Asian American writing. The late 1990s, however, witnessed the emergence of novels, memoirs, narrative and experimental films that departed from current notions of Asian American literature and films. A distinct cohort of writers and filmmakers, who are first-generation immigrants, created cultural forms that focus on the heimat or the homeland, narrating history, the legacies of war, violence, personal and national memory. The seminar considers how these fictional and non-fictional narratives engage with new aesthetic and political questions regarding Asian American writing, filmmaking and the limits and the possibilities of memory in the digital age.
3 credits, Letter graded (A, A-, B+, etc.)

AAS 565: Food, Labor and Asian America
¿An authentic taste of Asia¿ is a marketing phrase haunted by the violent histories of Orientalism, Western expansion and wars in Asia. In truth, the success and popularity of some Asian food is more than the celebration of the immigrant work ethic. Behind the popularity are geopolitical and labor issues. The consumption of beef and poultry in the U.S., for example, is intimately connected to the exploitation of immigrants from the global south. Undocumented immigrants and refugees from Southeast Asia, East Africa and the Americas perform the dirty task of slaughtering millions of animals: chickens, turkeys, pigs, ducks, sheep, lamb, calves. In 2009 alone, 33,300,000 cattle were killed for their meat in the United States. Immigrant laborers of American industrial slaughterhouses carry out dirty and dangerous work, killing and dismembering animals even as the laborers themselves live in crowded, unsanitary quarters. Similarly, the cooks of America¿s kitchens are immigrants from Asia and other parts of the world. This new MA course focuses on the emerging field known as ¿food studies¿ in particular the politics and histories of Asian food and its popularity in the United States. If the old adage is ¿we are what we eat,¿ what does it mean that Asian food in the U.S. is intimately connected to the histories of wars in Asia, undocumented labor, and the exploitation of immigrant food workers?
3 credits, Letter graded (A, A-, B+, etc.)

AAS 570: Intercultural Communication
Through combination of theory and research from discourse linguistics and linguistic anthropology, this course examines (i) how culture shapes ways of speaking; (ii) how language constructs identities, dispositions, role relations; and (iii) what challenges people from different cultures may face when they communicate with each other. The following analytical perspectives will be presented: speech act theory, ethnography of communication, linguistic politeness, and sequential organization of turn taking.
3 credits, Letter graded (A, A-, B+, etc.)

AAS 571: Islamic Thought in Asia
Islam is commonly considered a Middle-Eastern religion, but most of the Middle East lies within the Asian continent, and the vast majority of Muslims across the centuries have been non-Arabic speakers, living across south and central Asia into India, China, and Indonesia. We will survey the importance of Islam as the today¿s largest Asian religion (numerically speaking) and look at some of the distinctive features of its local variants. We will pay special attention to the manner in which teachings were presented in the languages besides Arabic that became Islam¿s vehicles, in particular Chines, which witnessed a remarkable synthesis of the Islamic and Confucian worldviews.
3 credits, Letter graded (A, A-, B+, etc.)

AAS 572: Topics in Asian Philosophy I
This course presents in-depth student of specific topic in an Asian philosophical tradition. Students are expected to demonstrate knowledge through mastery of native terms and concepts from that tradition. May be repeated as the topics changes.
3 credits, Letter graded (A, A-, B+, etc.)

May be repeated for credit.

AAS 573: Orientalism
Edward Said¿s Orientalism, written in 1978, was a polemical attack on the discipline of Orientalism and the representations of the ¿orient,¿ in western thought. Almost thirty years later, the debate still rages: are all western scholars writings about Asia complicit in imperialism? Is there such a thing as objective scholarship, or are power and knowledge so deeply intertwined that all intellectual activity is inherently political?

Taking our start from Said¿s ideas, we will look at authors who extended Said¿s critique to the fields of South Asian and East Asian Studies, and also examine some of Said¿s most outspoken critics. In investigating these issues, students will learn about some of the major figures in the history of Asian students. We will conclude the semester by exploring the possibilities for ¿post-orientalist¿ approaches to the study of Asian cultures and religions, and by examining the pervasiveness of orientalist themes in popular culture.
3 credits, Letter graded (A, A-, B+, etc.)

AAS 575: Multilingualism & Communication in Asia
Survey of multilingualism as a cognitive phenomenon and communication strategy with special reference to traditionally multilingual societies. Structural, sociolinguistic, cultural, and cognitive models are evaluated for their adequacy in representing multilingualism in Western and especially non-Western (Asian and African cultures. Topics include concepts of multilingualism, typology of multilingualism; functional distribution of languages in education, media, social media, and business; diglossia, code-switching and code-mixing, psycholinguistic and neurolinguistic models of multiple language representation and processing in the brain; synchronic and diachronic dimensions of language contact and interaction in the individual and society; accents, interference, transfer on various linguistic levels; borrowing, linguistic convergence, emergence of pidgins, creoles, mixed languages, styles, and non-native varieties; multilingualism as a pragmatic and stylistic literary device. Speech acts and multilingual creativity; sociopolitical dimensions of multilingualism: multilingualism and identity; accommodation and assimilation; language maintenance and shift; language rivalry and conflict; spread of languages of wider communication and minority languages; anxiety about hegemony and endangerment; cross-cultural case studies of pluralistic models of synergetic co-existence.
3 credits, Letter graded (A, A-, B+, etc.)

AAS 578: Chinese Sociolinguistics
Narrative readings in Chinese selected from Chinese newspapers and magazines, including news reports and narrations on lifestyles, people, and landscapes. Students are expected to improve their skills in the analysis and writing of narrative readings. This course is designed for students who already have advanced level proficiency in Chinese, who can read and write everyday vernacular Chinese, but who have not been exposed to more formal language and literary forms.
3 credits, Letter graded (A, A-, B+, etc.)

AAS 585: Translation Studies of Asian Languages
Inquiry into issues in the translation of Asian languages into/from English. This course introduces the recent theories and concepts of translation studies and applies them to the analysis of a variety of Asian texts as source
texts or target texts. Students are expected to gain insights into the lexical, grammatical, cognitive, pragmatic, and socio-cultural characteristics of Asian languages as well as social and political issues that surround translation of Asian texts. Texts to be analyzed include, but are not limited to, literary works, newspaper articles, advertisements, brochures, and business letters. Advanced skills in one of the Asian languages are required.

3 credits, Letter graded (A, A-, B+, etc.)

**AAS 587: Supervised Research in Contemporary Asian and Asian American Studies**

This course provides thesis credit for students in the graduate program, Contemporary Asian and Asian American Studies. Thesis credit. Independent graduate research under the supervision of a faculty member. May be repeated to a limit of 6 credits. Prerequisites: Approval of Director of Graduate Studies 1-6 credits, Letter graded (A, A-, B+, etc.) May be repeated 6 times FOR credit.

## ACC

### Accounting

**ACC 529: Managerial Accounting and Decision Making**

This course covers cost accounting concepts and theories and the implementation of an accounting system as a source of information for decision making, planning, control, and the evaluation of organizational performance by management. Other topics include cost-volume-profit analysis, overhead rates, budgeting and statement of cash flows. 3 credits, Letter graded (A, A-, B+, etc.)

**ACC 542: Accounting for the Small Business Entrepreneur**

This course is designed to introduce the student to accounting and other financial concepts that the small business entrepreneur needs to know in order to be successful. The course will reinforce accounting concepts already introduced in the Financial Accounting course with an emphasis on the small business. Other business/financial concerns such as bank reconciliations, payroll preparation, payroll and sales tax compliance, maintenance of installment debt, and utilization of sales and purchase discounts will be reviewed. Since most small business entrepreneurs need to either do their own bookkeeping or at least be intimately involved in the process this course requires the student to become familiar with two different accounting software packages (Quickbook and Peachtree). Prerequisite: Enrolled in Accounting MBA or MS program 3 credits, Letter graded (A, A-, B+, etc.)

**ACC 543: Corporate Governance**

This course aims to enable students to understand legal arrangement and social economic theories that are necessary for analyzing core issues of modern corporate governance. The role of accounting in corporate governance is emphasized. Prerequisite: Enrolled in Accounting MBA or MS program 3 credits, Letter graded (A, A-, B+, etc.)

**ACC 544: Financial Statement Analysis**

Financial statement analysis is central to fundamental analysis of business. This course is about the analysis of financial statements for making investment decisions. It integrates key elements from accounting, finance, and business strategy and applies them to financial decision-making. The course will be taught using a combination of lectures, case analyses, class discussions, and student presentations. Prerequisite: Enrolled in Accounting MBA or MS program 3 credits, Letter graded (A, A-, B+, etc.)

**ACC 545: Entity Taxation**

Introduces fundamental income taxation concepts for business entities. Coverage includes the formation, operation, reorganization and dissolution of C and S corporations. Topics associated with partnerships and LLCs entities are also reviewed. Students will be exposed to other areas of our Federal tax system, including U.S. multi-national, gift, estate, and fiduciary income tax topics. State nexus and financial accounting for income taxes concepts are also introduced. Prerequisite: Enrolled in Accounting MBA or MS program 3 credits, Letter graded (A, A-, B+, etc.)

**ACC 546: Information Security & Current Emerging Technologies in Accounting**

This course teaches students concepts on information security and protection of information assets. Also, it discusses important topics on IT governance and management including but not limited to IT risk management, IT controls, access controls and cyber security. Additionally, it covers emerging technologies and software applications commonly used in today's accounting profession. Prerequisite: Enrolled in Accounting MBA or MS program 3 credits, Letter graded (A, A-, B+, etc.)

**ACC 548: Information Security and Accounting**

This course is designed to introduce the student to accounting and other financial concepts that the small business entrepreneur needs to know in order to be successful. The course will reinforce accounting concepts already introduced in the Financial Accounting course with an emphasis on the small business. Other business/financial concerns such as bank reconciliations, payroll preparation, payroll and sales tax compliance, maintenance of installment debt, and utilization of sales and purchase discounts will be reviewed. Since most small business entrepreneurs need to either do their own bookkeeping or at least be intimately involved in the process this course requires the student to become familiar with two different accounting software packages (Quickbook and Peachtree). Prerequisite: Enrolled in Accounting MBA or MS program 3 credits, Letter graded (A, A-, B+, etc.)

**ACC 556: Analysis and Design of Accounting Systems**

A managerial approach to the concepts, issues and techniques used to successfully manage and maintain an "Accounting Information System." Topics will include business processes such as the revenue and expenditure cycles; business transactions including replenishment procedures and customer loyalty programs; general ledger output and compliance requirements as well as interfaces to OLAP environments. Prerequisite: Enrolled in Accounting MBA or MS program 3 credits, Letter graded (A, A-, B+, etc.)

**ACC 560: Contemporary Issues in Accounting**

The focus of this course is on contemporary issues facing the accounting profession. It serves as an academic culmination that draws upon other courses in the accounting curriculum. In exploring contemporary issues, students will more deeply consider the theoretical underpinnings and practical application of accounting principles generally accepted in the United States (GAAP); auditing procedures and auditing standards generally accepted in the United States (GAAS); federal taxation guidelines; and the profession's ethical, professional and legal responsibilities. Pedagogy includes extensive use of newsworthy accounting issues and the Financial Accounting Standards Codification, American Institute of Certified Public Accountants Auditing Standards, and the IRS Tax Code, Regulation, and Guidelines. Course is team taught by three accounting instructors. Prerequisite: Enrolled in Accounting MBA or MS program 3 credits, Letter graded (A, A-, B+, etc.)

**ACC 562: Advanced Auditing and Assurance**

This course builds on the foundation from an undergraduate Auditing and Assurance course, using case studies to motivate and develop a thorough understanding of how audit standards (GAAS), processes, and techniques facilitate the auditor's role of validating that financial statements are presented fairly and in accordance with Generally Accepted Accounting Principles (GAAP). Students will learn through case studies, classroom discussions, and projects. The course will also cover contemporary issues in auditing. Prerequisite: Enrolled in Accounting MBA or MS program
GRADUATE COURSE DESCRIPTIONS

Fall 2024

ACC 591: Internal Auditing
This course is designed to introduce the student to the goal of internal auditing, i.e., to understand, audit and report on an entity’s financial, compliance and operational control systems. The course will discuss how the internal auditor accomplishes this goal through professional standards and the best industry practices. This course will present information that will enable the student to understand how the internal audit process improves ethical behavior and operational efficiencies within the business environment. These sessions include discussions about the history of the internal audit function. Other topics discussed will be application in the banking industry, the Enron fraud and the resulting Sarbanes-Oxley legislation and application to local government environments. Finally, there will be discussion about the audit committee and how it relates to the internal audit. Prerequisite: Enrolled in Accounting MBA or MS program
3 credits, Letter graded (A, A-, B+, etc.)

ACC 594: Governmental and Not for Profit Accounting and Reporting
This course is designed to introduce the student to generally accepted accounting practices (GAAP) for both governmental and not-for-profit entities. The different accounting rules for each type of entity will be explored and compared to typical corporate accounting practices. The course will examine standards and issued by the two rule making bodies, i.e. the Financial Accounting Standards Board (FASB) and the Governmental Accounting Standards Board (GASB) and how they affect the accounting and financial reporting for the two types of entities. These sessions will include explanation of typical accounting transactions and the resulting financial statements. There will also be discussions about current financial events affecting both environments. Prerequisite: Enrolled in Accounting MBA or MS program
3 credits, Letter graded (A, A-, B+, etc.)

ACC 596: Financial Accounting Theory
This course explores the historical development and refinement of the conceptual framework of accounting theory as it relates to financial reporting. The implications of the convergence of International Accounting Standards, and Generally Accepted Accounting Principles (GAAP) in a global environment are discussed. Current accounting practices are analyzed and evaluated in the context of the conceptual framework of GAAP along with the discussion of research methodologies. Prerequisite: Enrolled in Accounting MBA or MS program
3 credits, Letter graded (A, A-, B+, etc.)

ACC 597: Advanced Accounting
This course provides the students with an in-depth, up-to-date coverage of accounting for consolidations, governmental, not-for-profit entities, and other key advanced topics. The course links theory and practice with constant emphasis on the logic of procedures.
3 credits, Letter graded (A, A-, B+, etc.)

ACC 598: Forensic Analytics in Accounting
The aim of this course is to explore and master the professional skills necessary to detect, investigate and prevent fraud. Students will learn how and why fraudulent activities are committed, and how allegations of fraud should be investigated and resolved. The use of technology to proactively detect fraud will be discussed. The following areas such as financial investigations, financial statement fraud, tax fraud, business valuation, resolution and litigation services will be covered. Prerequisite: Enrolled in Accounting MBA or MS program
3 credits, Letter graded (A, A-, B+, etc.)

AFH 524: Contemporary African American Diasporic Literature and Film
AFH 524: Contemporary African American Diasporic Literature and Film
AFH 520: The Caribbean and the Literary Imagination
An examination of the literary representation of the Caribbean through an extensive study of selected fictional and theoretical writings. This seminar will include an examination of the representations of the Caribbean by African American as well as Caribbean writers.
3 credits, Letter graded (A, A-, B+, etc.)

AFH 524: Contemporary African Diasporic Literature and Film
Contemporary African American Diasporic Literature and Film offers a comparative analysis of twentieth and twenty-first century African Diasporic writers and filmmakers and their explorations of race, class, and gender. To establish the shifting nature of African Diasporic intellectual thought, we shall consider how each successive generation of writers and filmmakers builds upon discussions of racial identity, black sexuality, and social mobility. To demonstrate how discussions of race have evolved over time texts will be read in conjunction with each other. So for example, Fanon's seminal test Black Skin White Masks, a text that seeks to explain the racialization of society, the double consciousness of black people, and the superiority complex of white people will be read against Paul Gilroy's Against Race, a text arguing for the deconstruction and recognition of race as a cultural construct. Other topics for discussion focus on how “newer” writers delve into questions of sexuality from a fresh perspective. Comparing Morrison's Sula with Cheryl West's play Before It Hits Home, for example, demonstrates that writers are now exploring questions of sexuality in more provocative ways. West's uncovering of the "downlow" life-style lived by Black men, and the health concerns related and the dangers of sexually transmitted diseases such as HIV/AIDS. Permission from advisor required.
3 credits, Letter graded (A, A-, B+, etc.)

AFH 528: Contemporary Black Literature and Cultural Criticism
This course introduces students to some of the major contemporary literary and cultural theorists from the twentieth and twenty-first centuries (Fanon, Baker, Christian, Gilroy, Mercer, Morrison, Gates, Patterson, CLR James, etc). Earlier scholars from the nineteenth century such as Anna Julia Cooper or Du Bois will also be referenced. Through an examination of major literary and cultural movements such as Negritude, the Caribbean Artists Movement, The Black Arts Movement, and the Post- Black Artists Movement, students will gain insight into how black scholars both critique and contribute to the artistic, political, and social discourse of the day. An application of Postcolonial, Feminist/Womanist, and Cultural Criticism will aid the students in their reading of the critical materials.
Offered
Fall, alternate years, 3 credits, Letter graded (A, A-, B+, etc.)

AFH 542: Independent Studies
AFH 542: Independent Studies
AFH 585: Independent Studies
Specialized in-depth exploration of topics related to Africana Studies core themes based on a contractual relationship between

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individual student and faculty. Student must gain permission of selected faculty to enroll in their section of this course. The course can be taken only twice in fulfillment of requirements for the M.A.

3 credits, Letter graded (A, A-, B+, etc.)

**AFH 599: Thesis**

This course is intended to prepare students in developing a sustained and mature (nuanced) argument for their M.A. thesis. The class is for credit with flexible attendance requirements. The student must have an AFH faculty sponsor (thesis director) who will be responsible for assigning a course grade. The class is available beginning in the second term of a student's enrollment in the M.A. program and in the summer upon approval of the Director of Graduate Studies.

6 credits, Letter graded (A, A-, B+, etc.)

**AFS**

**Africana Studies/Social and Behavioral Sciences**

**AFS 500: Foundations in Africana Studies, I**

Core course required of all students pursuing a master’s degree in Africana Studies. The two-semester foundations sequence will introduce students to the theoretical issues and historiography of the Africana Diaspora. The parameters of African Diaspora studies and will cover the historical, literary, sociopolitical, cultural, and economic themes of the black experience. The course will provide critical examination of the global experience and promote an understanding of the Black Diaspora focusing on scholarly works by Paul Gilroy, Chinua Achebe, Henry Louis Gates, Angela Davis, Walter Rodney, and others. Permission of advisor required.

Fall, 3 credits, Letter graded (A, A-, B+, etc.)

**AFS 501: Foundations in Africana Studies, II**

Core course required of all students pursuing a Master’s degree in Africana Studies. The two-semester foundations courses will introduce students to the theoretical issues and historiography of the Africana Diaspora. The parameters of Africana Diaspora studies will cover the historical, literary, sociopolitical, cultural, and economic themes of the black experience. The course will provide critical examination of the global experience and will cover the historical, literary, sociological, and historiography of the Africana studies. Students will be exposed to a variety of critical approaches across such disciplines as history, literature, political science, and sociology in the context of Africana studies. Students will examine the ways in which theoretical, ideological, and philosophical assumptions about race, class, and gender shape the kinds of research questions we ask and the types of instruments we use to investigate and evaluate the experiences and contributions of people from the African diaspora. Permission of advisor required.

Fall, 3 credits, Letter graded (A, A-, B+, etc.)

**AFS 502: Research Methods in Africana Studies**

This course introduces students to basic concepts of research methodology, specifically as they pertain to studies of the African diaspora. Students will be exposed to a variety of critical approaches across such disciplines as history, literature, political science, and sociology in the context of Africana studies. Students will examine the ways in which theoretical, ideological, and philosophical assumptions about race, class, and gender shape the kinds of research questions we ask and the types of instruments we use to investigate and evaluate the experiences and contributions of people from the African diaspora. Permission of advisor required.

Spring, 3 credits, Letter graded (A, A-, B+, etc.)

**AFS 503: Slavery and the Atlantic World**

This course will examine the experiences of people of African descent as participants in a coerced migration that created the African Diaspora. The transatlantic slave trade led to an enduring image of black men and women as transported commodities. Therefore, it has had the greatest impact on the construction of the African Diaspora giving rise to new communities of people across the globe.

Fall, 3 credits, Letter graded (A, A-, B+, etc.)

**AFS 504: Racialized Oppressions and the Idea of Humanity**

When one reads accounts of slavery, genocide, the systematic denial of rights to a group because of a racial identity, the question always arises whether the oppressors view the racialized other as fully human? This course will explore this question and what it means to view an individual or group as “fully human.” How have philosophical understandings of the moral importance and the moral meaning of “humanity” served to exacerbate, moderate or fight against racial oppression? How does racial and gender oppression compare in this respect? Is there a comparison to be made between racial oppression and the treatment accorded to disabled people with respect to the understanding of what it is to be human? Does shifting the ground from a biologically-based concept such as “humanity” to a philosophical concept of “personhood” serve to justify or serve as a tool against these identity-based oppressions? Does shifting the ground justify the analogy of racism with the abuse of animals, as in the idea of “speciesism”? We will explore this question and what it means to view an individual or group as “fully human.” How have philosophical understandings of the moral importance and the moral meaning of “humanity” served to exacerbate, moderate or fight against racial oppression? How does racial and gender oppression compare in this respect? Is there a comparison to be made between racial oppression and the treatment accorded to disabled people with respect to the understanding of what it is to be human? Does shifting the ground from a biologically-based concept such as “humanity” to a philosophical concept of “personhood” serve to justify or serve as a tool against these identity-based oppressions? Does shifting the ground justify the analogy of racism with the abuse of animals, as in the idea of “speciesism”? We will explore this question and what it means to view an individual or group as “fully human.”

Fall, 3 credits, Letter graded (A, A-, B+, etc.)

**AFS 507: African Music**

This is a selective introduction to African music, and the music of the African Diaspora. We will read from major scholars in the field of African music studies such as Simha Arom, Christopher Waterman, Gerhard Kubik, Michele Kisliuk, Ruth Stone, Kofi Agawu, and others. Students will get a broad overview of the music of the major regional subdivisions of Africa (for instance North Africa, Central Africa, South Africa, etc.), as well as a historical perspective on the musicological issues that have been central to Africaniast musicology and ethno musicology. There will be regular reading, listening, and short writing assignments, occasional quizzes, a book review, and a final research project of 16-18 pp. For the book review, students will write about a monograph on African Music such as John Miller Chernoff's African Rhythm and African Sensibility or Paul Berliner's The Soul of Mbira. Students will present their research to class towards the end of the term. Permission from course instructor required.

3 credits, Letter graded (A, A-, B+, etc.)

**AFS 533: Race, Gender, and Globalization**

This seminar explores current issues and debates relating to the racialized and gendered effects of globalization. Topics include an overview of the sociology of globalization and theories of globalization/the global system, transnational classes and a transnational state, global culture and ideology, transnational migrations and the new global labor market, globalization and race/ethnicity, women and globalization, local-global linkages, and resistance to globalization.

Offered Fall or Spring, 3 credits, Letter graded (A, A-, B+, etc.)

**AFS 536: Africa and Globalization**

This seminar will discuss the interconnection between these enduring crisis of the modern African state and the impact of globalization, especially after the collapse of communism in Eastern Europe. We will critically explore the implications of these complex regional and global political and economic forces for emerging African social formation, the viability of African states and societies, new
migration patterns, transnationalism, and diasporic connections especially since the decolonization process in the 1950's. Spring, 3 credits, Letter graded (A, A-, B+, etc.)

**AFS 540: The Black Power Movement**
This course examines the Black Power Movement. Stokely Carmichael's call for "Black Power!" broke through the commotion of everyday politics during 1966's Meredith March Against Fear. Soon after, and for the next decade, Black Power galvanized African American politics, engendering radical movements for social, political, and cultural transformation that impacted blacks in the United States and beyond. An emerging historiography traces the roots of Black Power in the postwar black freedom movement, finding cultural and political touchstones for future Black Power activism among civil rights renegade, trade unionists, and black nationalists. We will examine works produced during the Black Power era and new scholarship to analyze the Black Power Movement's legacy in the politics and culture of African Americans. Permission of advisor is required. This course is offered as both HIS 540 and AFS 540. 3 credits, Letter graded (A, A-, B+, etc.)

**AFS 541: Music and Race: Black Music (Cross Cultural Study of Music)**
This seminar will examine how certain widely held conceptualizations about race (and in some instances ethnicity) are articulated, reinforced, or challenged in music making and consumption, on the one hand, and in scholarship about music on the other. Writings on race and music have tended to be about "black" culture(s). In this course we will critique this focus and the construct of black music in great detail. The course requires extensive readings on these topics; listening to musical examples (in-depth knowledge of music theory is not necessary); vigorous class discussion and written reaction papers; a final research paper and class presentation. Students may choose to explore other aspects of music and race besides black music in their final papers (for example, how Orientalism has been constituted in music and musical criticism and scholarship). Permission of advisor required. 3 credits, Letter graded (A, A-, B+, etc.)

**AFS 542: Caribbean Transnational Identity in the US**
This course seeks to examine the strategies some immigrants from the Caribbean utilize to live their lives simultaneously in the US and the country of origin. To do so, it sheds light on the ways in which the US construction of race and ethnicity influences the immigrants' search for an identity in the United States. Prerequisite: Enrollment in the Graduate Certificate Program Fall, 3 credits, Letter graded (A, A-, B+, etc.)

This course explores the various ways in which gender, race, and class, along with other aspects of identity, shape the lives and experiences of women of color in the United States and globally. It presents the ongoing debates concerning the interconnections of gender, race, and shifting identities. It will examine the relationships between the construction of personal identities, identity statuses, cultural and ideological meaning systems, and the search for alternative images. Permission from advisor required. 3 credits, Letter graded (A, A-, B+, etc.)

**AFS 555: Sociology of Gender and Development**
The 1960's marked a transition in global economic relations from one characterized by colonial extraction and exploitation, to sustainable development emphasizing economic growth and the alleviation of poverty. It was quickly discovered, however, that the effects of development were beneficial for some but devastating for others, especially poor women. The discovery led many scholars and practitioners, especially those who embrace feminist ideologies, to demand that development agencies and policies be sensitive to gender issues. This seminar will focus on gender and development, in theory and practice, in the global South. It will promote students' understanding of the central role that gender plays in the success and assessment of development strategies. Fall or Spring, alternate years, 3 credits, Letter graded (A, A-, B+, etc.)

**AFS 560: Sexualities: African and Caribbean Perspectives**
This seminar is designed to introduce students to the complexities of human sexuality from a perspective that places subaltern individuals at the center of the analysis. It locates these individuals, and their sexual practices, in the Tropics (particularly in Africa and the Caribbean) first in those man-made communities where sexuality was one of the (unspoken) exigencies of the slave and colonial economies, and later in the modern era where these economies have given way to neo-colonies. 3 credits, Letter graded (A, A-, B+, etc.) Offered Spring, 3 credits, Letter graded (A, A-, B+, etc.)

**AFS 570: The Black Radical Tradition**
This course examines the black radical tradition from slavery to the present, paying particular attention of twentieth-century social movements and the intersection between trade unionism, black nationalism, internationalism, and Marxism. Black radicalism has a long history in the United States and beyond. At its core, this tradition has housed diverse, at times conflicting, ideological strains, personalities, and organizations ranging from black feminists, Marxists, socialists, liberals, trade unionists, artists, and intellectuals. In the process this tradition has run afloat of more mainstream expressions of Black protest (although in certain eras, such as during the Black Power Movement, it has represented the mainstream), and black radicals are often marginalized as wild-eyed dreamers, naive to the ways of the world. 3 credits, Letter graded (A, A-, B+, etc.)

**AFS 585: Independent Studies**
Specialized in-depth exploration of topics related to Africana Studies core themes based on a contractual relationship between individual student and faculty. Student must gain permission of selected faculty to enroll in their section of this course. The course can be taken only twice in fulfillment of requirements for the M.A. 3 credits, Letter graded (A, A-, B+, etc.) May be repeated for credit.

**AFS 599: Thesis**
This course is intended to prepare students in developing a sustained and mature (nuanced) argument for their M.A. thesis. The class is for credit with flexible attendance requirements. The student must have an AFS faculty sponsor (thesis director) who will be responsible for assigning a course grade. The class is available beginning in the second term of a student's enrollment in the M.A. program and in the summer upon approval of the Director of Graduate Studies. Fall and Spring 3-6 credits, Letter graded (A, A-, B+, etc.) May be repeated for credit.

**AFS 616: Twentieth Century African Political History**
This seminar is an extensive exploration of African political history in the twentieth-century. It examines the major themes that have shaped the formation and the decline of the modern African state since the imposition of colonial rule in the late nineteenth century. Drawing from monographs and journal articles.
AMS 501: Differential Equations and Boundary Value Problems I
3 credits, Letter graded (A, A-, B+, etc.)

AMS 502: Differential Equations and Boundary Value Problems II
Analytic solution techniques for, and properties of solutions of, partial differential equations, with concentration on second order PDEs. Techniques covered include: method of characteristics, separation of variables, eigenfunction expansions, spherical means. Green's functions and fundamental solutions, and Fourier transforms. Solution properties include: energy conservation, dispersion, dissipation, existence and uniqueness, maximum and mean value principles. Spring
3 credits, Letter graded (A, A-, B+, etc.)

AMS 503: Applications of Complex Analysis
A study of those concepts and techniques in complex function theory that are of interest for their applications. Pertinent material is selected from the following topics: harmonic functions, calculus of residues, conformal mapping, and the argument principle. Application is made to problems in heat conduction, potential theory, fluid dynamics, and feedback systems. Spring
3 credits, Letter graded (A, A-, B+, etc.)

AMS 504: Foundations of Applied Mathematics
An introductory course for the purpose of developing certain concepts and techniques that are fundamental in modern approaches to the solution of applied problems. An appropriate selection of topics is based on the concepts of metric spaces, compactness, sequences and convergence, continuity, differentiation and integration, function sequences, contraction mapping theorem. Strong emphasis on proofs. Fall
3 credits, Letter graded (A, A-, B+, etc.)

AMS 505: Applied Linear Algebra
Review of matrix operations. Elementary matrices and reduction of general matrices by elementary operations, canonical forms, and inverses. Applications to physical problems. Offered as AMS 505 or HPH 695. Fall
3 credits, Letter graded (A, A-, B+, etc.)

AMS 507: Introduction to Probability
The topics include sample spaces, axioms of probability, conditional probability and independence, discrete and continuous random variables, jointly distributed random variables, characteristics of random variables, law of large numbers and central limit theorem, Markov chains.
3 credits, Letter graded (A, A-, B+, etc.)

AMS 510: Analytical Methods for Applied Mathematics and Statistics
Review of techniques of multivariate calculus, convergence and limits, matrix analysis, vector space basics, and Lagrange multipliers.
Prerequisite: A course in linear algebra and in multivariate calculus
Fall
3 credits, Letter graded (A, A-, B+, etc.)

AMS 511: Foundations of Quantitative Finance
Introduction to capital markets, securities pricing and modern portfolio theory, including the organization and operation of securities market, the Efficient Market Hypothesis and its implications, the Capital Asset Pricing Model, the Arbitrage Pricing Theory and more general factor models. Common stocks and their valuation, statistical analysis, and portfolio selection in a single-period, mean-variance context will be explored along with its solution as a quadratic program. Fixed income securities and their valuation, statistical analysis, and portfolio selection. Discussion of the development and use of financial derivatives. Introduction to risk neutral pricing, stochastic calculus and the Black-Scholes Formula. Whenever practical examples will use real market data. Numerical exercises and projects in a high-level programming environment will also be assigned.
3 credits, Letter graded (A, A-, B+, etc.)

AMS 512: Capital Markets and Portfolio Theory
Development of capital markets and portfolio theory in both continuous time and multi-period settings. Utility theory and its application to the determination of optimal consumption and investment policies. Asymptotic growth under conditions of uncertainty. Applications to problems in strategic asset allocation over finite horizons and to problems in public finance. Whenever practical, examples will use real market data. Numerical exercises and projects in a high-level programming environment will also be assigned.
3 credits, Letter graded (A, A-, B+, etc.)
AMS 513: Financial Derivatives and Stochastic Calculus
Further development of derivative pricing theory including the use of equivalent martingale measures, the Girsanov Theorem, the Radon-Nikodym Derivative, and a deeper, more general understanding of the Arbitrage Theorem. Numerical approaches to solving stochastic PDE’s will be further developed. Applications involving interest rate sensitive securities and more complex options will be introduced. Whenever practical examples will use real market data. Numerical exercises and projects in a high-level programming environment will also be assigned. Prerequisite: AMS 511. 3 Credits
3 credits, Letter graded (A, A-, B+, etc.)

AMS 514: Computational Finance
Review of foundations: stochastic calculus, martingales, pricing, and arbitrage. Basic principles of Monte Carlo and the efficiency and effectiveness of simulation estimators. Generation of pseudo- and quasi-random numbers with sampling methods and distributions. Variance reduction techniques such as control variates, antithetic variates, stratified and Latin hypercube sampling, and importance sampling. Discretization methods including first and second order methods, trees, jumps, and barrier crossings. Applications in pricing American options, interest rate sensitive derivatives, mortgage-backed securities and risk management. Whenever practical examples will use real market data. Extensive numerical exercises and projects in a general programming environment will also be assigned.

3 credits, Letter graded (A, A-, B+, etc.)

AMS 515: Case Studies in Machine Learning and Finance
The course will cover applications of Quantitative Finance to risk assessment, portfolio management, cash flow matching, securities pricing and other topics. Particular attention will be paid to machine learning approaches, such as neural networks and support vector machines, data collection and analysis, the design and implementation of software. We will study differences between theory and practice in model application, including in-sample and out-of-sample analysis.

3 credits, Letter graded (A, A-, B+, etc.)

AMS 516: Statistical Methods in Finance
The course introduces statistical methodologies in quantitative finance. Financial applications and statistical methodologies are intertwined in all lectures. The course will cover regression analysis and applications to the Capital Asset Pricing Model and multifactor pricing models, principal components and multivariate analysis, statistical methods for financial time series; value at risk, smoothing techniques and estimation of yield curves, and estimation and modeling of volatilities. Prerequisite: AMS 507 3 credits, ABCF grading
3 credits, Letter graded (A, A-, B+, etc.)

AMS 517: Quantitative Risk Management
The course will cover structural and reduced-form approach to pricing credit default, Markovian models (or rating-based) pricing methods, statistical inference of relative risks, counting process, correlated (or dependent) default times, copula methods and pricing models for CDOs. Prerequisite: AMS 507 and AMS 511 3 credits, ABCF grading
3 credits, Letter graded (A, A-, B+, etc.)

AMS 518: Advanced Stochastic Models, Risk Assessment, and Portfolio Optimization
The course provides a thorough treatment of advance risk measurement and portfolio optimization, extending the traditional approaches to these topics by combining distributional models with risk or performance measures into one framework. It focuses on, among others, the fundamentals of probability metrics and optimization, new approaches to portfolio optimization and a variety of essential risk measures. Numerical exercises and projects in a high-level programming environment will be assigned. Prerequisite: AMS 512 or AMS 516 or AMS 522
Fall, 3 credits, Letter graded (A, A-, B+, etc.)

AMS 519: Internship in Quantitative Finance
Supervised internship in financial institution. Students will typically work at a trading desk, in an asset management group, or in a risk management group. Students will be supervised by a faculty member and a manager at their internship site. Written and oral reports will be made to both supervisors. Offered every semester, 3-6 credits, ABCF grading
3-6 credits, Letter graded (A, A-, B+, etc.)
May be repeated 2 times FOR credit.

AMS 520: Machine Learning in Quantitative Finance
This course will merge ML and traditional quantitative finance techniques employed at investment banks, asset management, and securities trading firms. It will provide a systematic introduction to statistical learning and machine learning methods applied in Quantitative Finance. The topics discussed in the course fall broadly into four categories which (as time permits) will be discussed in this order: Probabilistic Modeling, Feedforward neural networks, Sequential Learning, and Reinforcement Learning. Prerequisite: AMS 572& AMS 595 (or AMS 561 or based on Python knowledge per Instructor Consent)
3 credits, Letter graded (A, A-, B+, etc.)

AMS 522: Bayesian Methods in Finance
The course explores in depth the fundamentals of the Bayesian methodology and the use of the Bayesian theory in portfolio and risk management. It focuses on, among other topics, incorporating the prior views of analysts and investors into the asset allocation process, estimating and predicting volatility, improving risk forecasts, and combining the conclusions of different models. Numerical exercises and projects in a high-level programming environment will be assigned.
3 credits, Letter graded (A, A-, B+, etc.)

AMS 523: Mathematics of High Frequency Finance
Elements of real and complex linear spaces. Fourier series and transforms, the Laplace transform and z-transform. Elements of complex analysis including Cauchy theory, residue calculus, conformal mapping and Mobius transformations. Introduction to convex sets and analysis in finite dimensions, the Legendre transform and duality. Examples are given in terms of applications to high frequency finance. Offered
Fall, 3 credits, Letter graded (A, A-, B+, etc.)

AMS 524: Modern Computational Data Analytics
This course introduces the tools for the analysis of big data sets on server machines. It teaches how to store, preprocess, analyze and visualize data arriving at high volume and velocity. In the first part of the course, we will cover programming in Python, from its basic libraries to more advanced methods for big data analytics, and machine learning. Emphasis will be on the implementation in Python and practical hands-on examples. Next, we will learn essential Shell scripting and terminal window commands for computations on server machines. We will introduce database management systems and SQL querying. In the second part of the course, we will discuss code version control and collaboration solutions in GitHub and GitHub Actions, microservices,
AMS 525: Geometric Deep Learning
In the first part of the course, we will cover programming in Python, from its basic libraries up to the implementation of advanced deep learning models such as CNNs, RNNs, GNNs, and Transformer networks. The practical success of many of these models in high-dimensional problems such as image processing, playing GO, or protein folding comes from the predefined regularities in the underlying low-dimensional geometric structure of the data. Therefore in the second part of the course, we will extend the aforementioned deep learning models and their implementations to graphs and manifolds in spatial and spectral domains. The focus will be on the implementation of the models in Python and their practical applications.

AMS 526: Numerical Analysis I

AMS 527: Numerical Analysis II
Numerical methods based upon functional approximation: polynomial interpolation and approximation; and numerical differentiation and integration. Solution methods for ordinary differential equations. AMS 527 may be taken whether or not the student has completed AMS 526.

AMS 528: Numerical Analysis III
An introduction to scientific computation, this course considers the basic numerical techniques designed to solve problems of physical and engineering interest. Finite difference methods are covered for the three major classes of partial differential equations: parabolic, elliptic, and hyperbolic. Practical implementation will be discussed. The student is also introduced to the important packages of scientific software algorithms. AMS 528 may be taken whether or not the student has completed AMS 526 or AMS 527.

AMS 530: Principles in Parallel Computing
This course is designed for both academic and industrial scientists interested in parallel computing and its applications to large-scale scientific and engineering problems. It focuses on the three main issues in parallel computing: analysis of parallel hardware and software systems, design and implementation of parallel algorithms, and applications of parallel computing to selected problems in physical science and engineering. The course emphasizes hands-on practice and understanding of algorithmic concepts of parallel computing.

Prerequisite: A course in basic computer science such as operating systems or architectures or some programming experience.

AMS 531: Laboratory Rotations in Computational Biology
This is a two semester course in which first year Ph.D. students spend at least 8 weeks in each of three different laboratories actively participating in the research of participating Computational Biology Faculty. At the end of each rotation, students give a presentation of their lab activates and accomplishments. The primary goal of rotations is to help students choose a research advisor and to help faculty members choose students. Students register for AMS 531 in both the Fall and Spring semesters of the first year.

AMS 532: Journal Club in Computational Biology
The goal of this course is for students to hone critical reading and analytic skills through discussions of literature in the area of Computational Biology. Participants take turn being a "discussion leader" who informally guides the group through a peer-reviewed manuscript for which all Journal Club members will have to read in advance of the meeting. Meetings in the Spring semester will include in Person Training (IPT) in Responsible conduct of Research and Scholarship (RCRS) on topics that comprise (1) Integrity in Scholarship, (2) Scientific Misconduct, (3) Mentoring, (4) Ownership and Authorship, (5) Plagiarism, (6) Data Management, (7) Journalism and Science, (8) Human Subjects, and (9) Laboratory Animals.

AMS 533: Numerical Methods and Algorithms in Computational Biology
An in-depth survey of many of the key techniques used in diverse aspects of computational biology. A major focus of this class is on how to successfully formulate a statement of the problem to be solved, and how that formulation can guide in selecting the most suitable computational approach. Examples will be drawn from a wide range of problems in biology, including molecular modeling, biochemical reaction networks, microscopy and systems biology. No prior knowledge of biology is required.

AMS 534: Introduction to Systems Biology
This course is geared towards teaching essential concepts and computational skills in Systems Biology. The course is centered upon two key programming languages: Matlab for modeling applications and the R language for statistical analysis and sequence manipulation.

AMS 535: Introduction to Computational Structural Biology and Drug Design
This course will provide an introduction to Computational Structural Biology with application to Drug Design. Methods and applications that use computation to model biological systems involved in human disease will be emphasized. The course aims to foster collaborative learning and will consist of presentations by the instructor, guest lecturers, and by course participants with the goal of summarizing key methods, topics, and papers relevant to Computational Structural Biology. All are welcome to attend. Grades are based on the quality of the presentations, participation in class discussion, attendance, and quizzes.

AMS 536: Molecular Modeling of Biological Molecules
This computer-based lab course is designed for students who wish to gain hands-on experience modeling biological molecules at the atomic level. In conjunction with individual interests, Molecular Mechanics, Docking, De novo Design, and Molecular Dynamics software packages can be used to study relevant biological systems(s). Simulations will include setup, execution, and analysis. Course participants will carry out an independent research project, present their progress, and a final research report will
be required. Familiarity with Unix (Linux) is desirable but not mandatory.

3 credits, Letter graded (A, A-, B+, etc.)

AMS 537: Biological Dynamics and Networks
This course will provide a solid foundation in key theoretical concepts for the study of dynamics in biological systems and networks at different scales ranging from the molecular level to metabolic and gene regulatory networks. Topics of this course include but are not limited to: Physical kinetics; Diffusion/Smoluchowski; Random flights; Waiting times; Poisson; Brownian ratchets; Chemical kinetics; Transition states; Stability, bifurcations, pattern development; Noise in cells: intrinsic and Extrinsic; Feedback; Biological Oscillators; Recurrence, period doubling, chaos; Networks; Topologies; Degree distribution, betweenness; Models of nets: Erdos-Renyi, scale-free, social, Watts-Strogatz, agents; Robustness, highly-optimized tolerance, bowties, epidemics; Biological networks: Protein-protein nets, regulatory and metabolic nets; Known biological circuits and their behaviors; How networks evolve: Preferential attachment, rewiring; Power laws; Flucted through networks; Information and communication, entropy; Metabolic flux analysis; Artificial and Natural selection for traits; Darwinian evolution; Population dynamics.

Spring, 3 credits, Letter graded (A, A-, B+, etc.)

AMS 538: Methods in Computational Biology
Our emphasis will be algorithmic, on computational biology and bioinformatics. This course focuses on current problems in computational biology and bioinformatics. Prerequisite: AMS 538 and CSE 548.

0-3 credits, Letter graded (A, A-, B+, etc.)

AMS 540: Linear Programming

3 credits, Letter graded (A, A-, B+, etc.)

AMS 542: Analysis of Algorithms
Techniques for designing efficient algorithms, including choice of data structures, recursion, branch and bound, divide and conquer, and dynamic programming. Complexity analysis of searching, sorting, matrix multiplication, and graph algorithms. Standard NP-complete problems and polynomial transformation techniques. This course is offered as both AMS 542 and CSE 548.

3 credits, Letter graded (A, A-, B+, etc.)

AMS 544: Discrete and Nonlinear Optimization
Theoretical and computational properties of discrete and nonlinear optimization problems: integer programming, including cutting plane and branch and bound algorithms, necessary and sufficient conditions for optimality of nonlinear programs, and performance of selected nonlinear programming algorithms.

3 credits, Letter graded (A, A-, B+, etc.)

AMS 545: Computational Geometry
Study of the fundamental algorithmic problems associated with geometric computations, including convex hulls, Voronoi diagrams, triangulation, intersection, range queries, visibility, arrangements, and motion planning for robotics. Algorithmic methods include plane sweep, incremental insertion, randomization, divide-and-conquer, etc. This course is offered as both AMS 545 and CSE 555.

3 credits, Letter graded (A, A-, B+, etc.)

AMS 546: Network Flows
Theory of flows in capacity-constrained networks. Topics include maximum flow, feasibility criteria, scheduling problems, matching and covering problems, minimum-length paths, minimum-cost flows, and associated combinatorial problems.

3 credits, Letter graded (A, A-, B+, etc.)

AMS 547: Discrete Mathematics
This course introduces such mathematical tools as summations, number theory, binomial coefficients, generating functions, recurrence relations, discrete probability, asymptotics, combinatorics, and graph theory for use in algorithmic and combinatorial analysis. This course is offered as both CSE 547 and AMS 547.

3 credits, Letter graded (A, A-, B+, etc.)

AMS 548: Optimization techniques in biomolecular simulations
This practical hands-on course will teach basic techniques for building mathematical models, algorithms, and software for biomolecular simulations of macromolecular interactions. The topics of this course include, but are not limited to: the basics of statistical mechanics and its connection to the sampling algorithms; the origin of and approximations for the computation of molecular forces; geometry of the molecular configuration space search and multidimensional optimization; basics of software development and programming for high performance computing (HPC). During the course, the students will develop a multiscale approach for modeling protein-protein interactions from the ground up. No special background is required. Offered in the Spring Semester

AMS 549: Computational Biology
This course focuses on current problems in computational biology and bioinformatics. Our emphasis will be algorithmic, on discovering appropriate combinatorial algorithm problems and the techniques to solve them. Primary topics will include DNA sequence assembly, DNA/protein sequence comparison, hybridization array analysis, RNA and protein folding, and phylogenetic trees.

3 credits, Letter graded (A, A-, B+, etc.)

AMS 550: Operations Research: Stochastic Models
Includes Poisson processes, renewal theory, discrete-time and continuous-time Markov processes, Brownian motion, applications to queues, statistics, and other problems of engineering and social sciences. Prerequisite: AMS 507 or equivalent

3 credits, Letter graded (A, A-, B+, etc.)

AMS 552: Game Theory I
Elements of cooperative and non-cooperative games. Matrix games, pure and mixed strategies, and equilibria. Solution concepts such as core, stable sets, and bargaining sets. Voting games, and the Shapley and Banzhaff power indices. This course is offered as both ECO 604 and AMS 552. Prerequisite for ECO 604: Graduate standing in the Economics
Recent progress on big data systems, algorithms and networks. Topics include the web graph, search engines, targeted advertisements, online algorithms and competitive analysis, and analytics, storage, resource allocation, and security in big data systems. Offered in the Spring Semester
3 credits, Letter graded (A, A-, B+, etc.)

**AMS 561: Introduction to Computational Science**
This course provides a foundation of knowledge and basic skills for the successful application in graduate research of modern techniques in computational and data science relevant to engineering, the humanities, and the physical, life and social sciences. It is consciously crafted to provide a rich, project-oriented, multidisciplinary experience that establishes a common vocabulary and skill set. Centered around the popular programming language Python, the course will serve as an introduction to programming including data structures, algorithms, numerical methods, basic concepts in computer architecture, and elements of object-oriented design. Also introduced will be important concepts and tools associated with the analysis and management of data, both big and small, including basic statistical modeling in R, stochastic games. The Shapley value of games with and without complete information, and incomplete information, repeated games with and without complete information. Refinements of strategic equilibrium, games with incomplete information, repeated games and their own design. This course is offered as both ECO 605 and AMS 555.

Prerequisite for AMS 555: AMS 552/ECO 604. Spring, 3 credits, Letter graded (A, A-, B+, etc.)

AMS 562: Introduction to Scientific Programming in C++
This course provides students with foundational skills and knowledge in practical scientific programming relevant for scientists and engineers. The primary language is C++ and it is a widely-used, object-oriented language, including C as a subset, and is a powerful tool for writing robust, complex, high-performance software. Elements of Python, Bash, and other languages will be introduced to complement the capabilities of C++, and essential tools for software development and engineering will be employed throughout the course (e.g., makefiles, version control, online code repositories, debugging, etc.).

Fall, 3 credits, Letter graded (A, A-, B+, etc.)

AMS 565: Wave Propagation
3 credits, Letter graded (A, A-, B+, etc.)

**AMS 566: Compressible Fluid Dynamics**
Physical, mathematical, and computational description in compressible fluid flows. Integral and differential forms of the conservation equations, one-dimensional flow, shocks and expansion waves in two and three dimensions, quasi-one-dimensional flow, transient flow, numerical methods for steady supersonic flow, numerical methods for transient flow.

Spring, 3 credits, Letter graded (A, A-, B+, etc.)

AMS 569: Probability Theory I

Prerequisite: AMS 510 3 credits, ABCF grading
3 credits, Letter graded (A, A-, B+, etc.)

**AMS 570: Introduction to Mathematical Statistics**
Probability and distributions; multivariate distributions; distributions of functions of random variables; sampling distributions; limiting distributions; point estimation; confidence intervals; sufficient statistics; Bayesian estimation; maximum likelihood estimation; statistical tests.
Prerequisite: AMS 507
Spring, 3 credits, Letter graded (A, A-, B+, etc.)

AMS 571: Mathematical Statistics
Sampling distribution; convergence concepts; classes of statistical models; sufficient statistics; likelihood principle; point estimation; Bayes estimators; consistency; Neyman-Pearson Lemma; UMP tests; UMPU tests; Likelihood ratio tests; large sample theory. Offered as HPH 697 or AMS 571.
Prerequisite: AMS 570
3 credits, Letter graded (A, A-, B+, etc.)

AMS 572: Data Analysis I
Introduction to basic statistical procedures. Survey of elementary statistical procedures such as the t-test and chi-square test. Procedures to verify that assumptions are satisfied. Extensions of simple procedures to more complex situations and introduction
to one-way analysis of variance. Basic exploratory data analysis procedures (stem and leaf plots, straightening regression lines, and techniques to establish equal variance). Offered as AMS 572 or HPH 699.

AMS 573: Categorical Data Analysis
Measuring the strength of association between pairs of categorical variables. Methods for evaluating classification procedures and interrater agreement. Analysis of the associations among three or more categorical variables using log linear models. Logistic regression.
Prerequisite: AMS 572
Spring, 3 credits, Letter graded (A, A-, B+, etc.)

AMS 575: Internship in Statistical Consulting
Directed quantitative research problem in conjunction with currently existing research programs outside the department. Students specializing in a particular area work on a problem from that area; others work on problems related to their interests, if possible. Efficient and effective use of computers. Each student gives at least one informal lecture to his or her colleagues on a research problem and its statistical aspects.
1-9 credits, Letter graded (A, A-, B+, etc.) May be repeated for credit.

AMS 577: Multivariate Analysis
3 credits, Letter graded (A, A-, B+, etc.)

AMS 578: Regression Theory
Classical least-squares theory for regression including the Gauss-Markov theorem and classical normal statistical theory. An introduction to stepwise regression, procedures, and exploratory data analysis techniques. Analysis of variance problems as a subject of regression. Brief discussions of robustness of estimation and robustness of design. Prerequisite: AMS 572
3 credits, Letter graded (A, A-, B+, etc.)

AMS 580: Statistical Learning
This course will first review classical linear and generalized linear models such as Linear Regression, and Linear Discriminant Analysis. We shall then study modern Resampling Methods such as Bootstrapping, and modern variable selection methods such as the Shrinkage Method. Finally, we shall introduce modern non-linear statistical learning methods such as the Generalized Additive Models, Decision Trees, Random Forest, Boosting, Bagging, and Support Vector Machines.
3 credits, Letter graded (A, A-, B+, etc.)

AMS 581: Analysis of Variance
Analysis of models with fixed effects. The Gauss-Markov theorem; construction of confidence ellipsoids and tests with Gaussian observations. Problems of multiple tests of hypotheses. One-way, two-way, and higher-order layouts. Analysis of incomplete designs such as Latin squares and incomplete blocks. Analysis of covariance problems.
3 credits, Letter graded (A, A-, B+, etc.)

AMS 582: Design of Experiments
Discussion of the accuracy of experiments, partitioning sums of squares, randomized designs, factorial experiments, Latin squares, confounding and fractional replication, response surface experiments, and incomplete block designs. Offered as AMS 582 or HPH 699. Prerequisite: AMS 572
3 credits, Letter graded (A, A-, B+, etc.)

AMS 583: Applied Longitudinal Data Analysis
Longitudinal data takes the form of repeated measurements of the same subject (humans, animals, plants, samples, etc) over time (or other conditions). This type of data has a broad range of applications, including public health, medical research, pharmaceutical studies, life sciences, agriculture, engineering and physical sciences. Longitudinal data analysis allows one to study the changes in mean response over time and answer other scientific questions pertaining to the relationship between the response and time. This course aims to introduce statistical models and methods for the analysis of longitudinal data. Both the classical (univariate and multivariate repeated analysis of variance) and more recent approaches (1) general linear models for correlation, random coefficient models, linear mixed effect models for normal repeated measurements; (2) generalized linear models for non-normal response and population-averaged models (generalized estimating equations) for non-normal repeated measurements, of analyzing longitudinal data will be covered in this course. Offered in the Spring Semester
3 credits, Letter graded (A, A-, B+, etc.)

AMS 585: Internship in Data Science
Directed data science problem in conjunction with currently existing research programs outside the department. Students specializing in a particular area work on a problem from that area; others work on problems related to their interests, if possible. Efficient and effective use of computers. Each student gives at least one informal lecture to his or her colleagues on a research problem and its statistical aspects.
1-9 credits, Letter graded (A, A-, B+, etc.) May be repeated for credit.

AMS 586: Time Series
Analysis in the frequency domain. Periodograms, approximate tests, relation to regression theory. Pre-whitening and digital filters. Common data windows. Fast Fourier transforms. Complex demodulation, Gibb’s phenomenon issues. Time-domain analysis. Prerequisites: AMS 570 or AMS 572 3 credits, ABCF grading
3 credits, Letter graded (A, A-, B+, etc.)

AMS 587: Nonparametric Statistics
This course covers the applied nonparametric statistical procedures: one-sample Wilcoxon tests, two-sample Wilcoxon tests, runs test, Kruskal-Wallis test, Kendall’s tau, Spearman’s rho, Hodges-Lehman estimation, Friedman analysis of variance on ranks. The course gives the theoretical underpinnings to these procedures, showing how existing techniques may be extended and new techniques developed. An excursion into the new problems of multivariate nonparametric inference is made.
Prerequisites: AMS 312 and AMS 572 or equivalents
Fall, 3 credits, Letter graded (A, A-, B+, etc.)

AMS 588: Failure and Survival Data Analysis
This course introduces both parametric and non-parametric statistical models for analysis of the failure and survival data. A critical topic in quantitative finance, econometrics, and biostatistics. Different censoring mechanisms will be discussed. The course will mainly cover Kaplan-Meier estimator for characterizing the distribution of the failure and survival data, non-parametric log-rank test for comparing multiple groups, and the accelerated failure time model and Cox regression model uncovering various predictor/explanatory variables to survival/failure. Applications to finance, economics and biomedicine will be illustrated. We have revised the course title and content to better suit our current graduate programs in Applied Mathematics and Statistics that have evolved substantially from our old forms. In our current program, students from many tracks, especially in statistics and in quantitative finance, need this updated course as a highly
relevant and important elective. This same subject is generally referred to as ‘Survival data analysis’ in biostatistics, but ‘Failure data analysis’ in finance. This updated title will reflect the content of the course clearly for students from all tracks.

3 credits, Letter graded (A, A-, B+, etc.)

AMS 589: Quantitative Genetics
Definition of relevant terminology. Statistical and genetic models for inheritance of quantitative traits. Estimation of effects of selection, dominance polygenes, epistasis, and environment. Linkage studies and threshold characteristics.

Spring, odd years, 3 credits, Letter graded (A, A-, B+, etc.)

AMS 591: Topics for M.S. Students
Various topics of current interest in applied mathematics will be offered if sufficient interest is shown. Several topics may be taught concurrently in different sections.

3 credits, Letter graded (A, A-, B+, etc.) May be repeated for credit.

AMS 592: Mathematical Methods of Finance and Investments I
A broad-based course in mathematical modeling and quantitative analysis of financial transactions and investment management issues such as debt and equity, measures of risk and returns, efficient markets and efficient set mathematics, asset pricing, one-factor and multiple-factor models, portfolio selection, futures and options.

Fall, 3 credits, Letter graded (A, A-, B+, etc.)

AMS 593: Interest Rate and Credit Modeling
Introduction to most commonly used interest rate models: Heath-Jarrow-Morton, Brace-Gatarek-Musiela, etc. Cap, Floor, European and Bermudian option pricing. Credit Modeling: Merton structural approach vs. Intensity approach. Corporate bonds, CDS, securitized products (CDO, CLO, mortages), Credit value adjustment (CVA, XVA).

3 credits, Letter graded (A, A-, B+, etc.)

AMS 594: Mathematical Methods of Finance and Investments II
This course employs the techniques of mathematical statistics and empirical finance, e.g., estimation theory, linear and nonlinear regression, time series analysis, modeling and simulation to examine critically various models of prediction for asset-pricing, pricing of derivative products and term-structure of interest rates assuming stochastic volatility.

Statistics necessary for analysis is incorporated in the course.

Prerequisite: AMS 592
Fall, 3 credits, Letter graded (A, A-, B+, etc.)

AMS 595: Fundamentals of Computing
Introduction to UNIX operating system, C language, graphics, and parallel supercomputing.

Fall, 3 credits, Letter graded (A, A-, B+, etc.)

AMS 596: Fundamentals of Large-Scale Computing
Overview of the design and maintenance of large scale computer projects in applied mathematics, including basic programming techniques for massively parallel supercomputers.

Prerequisite: AMS 595 or permission of instructor
Spring, 1 credit, Letter graded (A, A-, B+, etc.)

AMS 597: Statistical Computing
Introduction to statistical computing using SAS and S plus.

Fall, 3 credits, Letter graded (A, A-, B+, etc.)

AMS 598: Big Data Analysis
This course introduces the application of the supercomputing to statistical data analyses, particularly on big data. Implementations of various statistical methodologies within parallel computing framework are demonstrated through all lectures. The course will cover (1) parallel computing basics, including architecture on interconnection networks, communications methodologies, algorithm and performance measurements, and (2) their applications to modern data mining techniques, including modern variable selection/Dimension reduction, linear/logistical regression, tree-based classification methods, Kernel-based methods, non-linear statistical models, and model inference/Resampling methods.

3 credits, Letter graded (A, A-, B+, etc.)

AMS 599: Research
Thesis research for Doctoral students who have not yet advanced to candidacy. Master’s students may also enroll, but must have approval from a faculty advisor before registering. Pre-requisite: Student must obtain consent from individual faculty advisor in order to register for AMS 599 under his/her section. 1-12 credits, S/U grading, may be repeated for credit.

1-12 credits, S/U grading

May be repeated for credit.

AMS 600: Socially Responsible Investing
Introduction to a scope of investments which are socially responsible because of the nature of the business the company conducts, including but not limited to: avoiding investment in companies that produce or sell addictive substances (like alcohol, gambling, and tobacco) and seeking out companies engaged in environmental sustainability. The course includes analysis of investments strategies maximizing financial return as well as social goods, such as: (i) Negative Screening: excluding securities with potentially social and/or environmental harmful characteristics; (ii) Shareholder activism: activities steering the management towards enhancing the well being of the stockholders, customers, employees, vendors, and communities. (iii) Positive investing: making investments in activities and companies believed to have a positive impact on issues such as social justice and the environment through stock selection, that guarantees sustainability, in environmental and humanitarian sense, and providing a company’s long term potential to compete and succeed. Offered in Fall.

3 credits, Letter graded (A, A-, B+, etc.)

AMS 601: Risk Management and Business Risk Control in BRIC Countries
Introduction to the challenges and opportunities in investing in the BRIC countries Brazil, Russia, India, and China, with emphasis in the risk assessment, control and management. Opportunities in investing in BRIC: growth in infrastructure, middle class demand, educated cheap workforce, potential for outsourcing work, high risk/ high reward. Risks facing investors in BRIC: strategic, operational, political, market risk, credit risks. Cultural barriers: family owned businesses, lack of business professionalism, poor transparency and disclosures of business practices, shallow and volatile markets, unstable macro-economics policies, tardy legal system. Responsibilities of investors in the BRIC countries: helping the BRIC governments and corporations in smooth transition to global markets and to developed status, providing co-ordination and transfer of business knowledge and technology from risk professionals in developed countries to emerging markets. Offered in Fall.

3 credits, Letter graded (A, A-, B+, etc.)

AMS 603: Risk Measures For Finance & Data Analysis
Risk analysis is important to quantitative finance, insurance, commercial credit and
many areas of data analysis. We emphasize risk analysis methods that capture observed features of risk, such as heavy tails, and validation of risk models against observed data. Students will be graded on the basis of projects drawn from multiple asset classes considered in the course work, including fixed income, options, portfolio optimization and foreign exchange. Professional standards for software development will be followed. Guest lectures by industry leaders will be included. Participation via conferencing software will be available. The course is open to all AMS graduate students and, with the instructor's permission, to CEAS graduate students.

3 credits, Letter graded (A, A-, B+, etc.)
May be repeated 1 times FOR credit.

AMS 621: Finite Element Methods for Partial Differential Equations
Variational form of the problem, Ritz Galerkins, collocation, and mixed methods; triangular, rectangular (2-D), and tetrahedral (3-D) elements; accuracy, convergence, and stability; solutions of linear, nonlinear steady-state, and dynamic problems; implicit and explicit time integration; equivalence of finite-element and finite-difference methods.

3 credits, Letter graded (A, A-, B+, etc.)

AMS 641: Special Topics in Mathematical Programming
The course is designed for second- and third-year graduate students with a strong foundation in linear algebra and analysis who wish to pursue research in applied mathematics. Varying topics from nonlinear programming and optimization to applied graph theory and applied combinatorics may be offered concurrently.

3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

AMS 644: Special Topics in Applied Probability
The course is designed for second- and third-year graduate students with a background in probability and stochastic modeling who wish to pursue research in applications of the probability theory. Several topics may be taught concurrently in different sections.

Prerequisites: AMS 550 and permission of instructor
Fall, 3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

AMS 651: Nonlinear Analysis and Optimization

3 credits, Letter graded (A, A-, B+, etc.)

AMS 652: Special Topics in Game Theory
The course is designed for second- and third-year graduate students who wish to specialize in the mathematical theory of games.

3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

AMS 670: Special Topics in Probability and Mathematical Statistics
The course is designed for second- and third-year graduate students with a strong foundation in analysis and statistics who wish to pursue research in mathematical statistics. Several topics may be taught concurrently in different sections.

3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

AMS 675: Special Topics in Applied Statistics
The course is designed for second- and third-year students with a strong foundation in statistical analysis who wish to pursue research in applied statistics.

3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

AMS 676: Internship in Applied Mathematics
Directed research and/or practical experience in industry, financial and consulting firms, and research institutions. Students are required to have a department faculty adviser who coordinates and supervises the internship. Submission of the final report is required.

1-9 credits, S/U grading
May be repeated for credit.

AMS 683: Biological Physics & Biophysical Chemistry: Theoretical Perspectives
This course will survey a selected number of topics in biological physics and biophysical chemistry. The emphasis is on the understanding of physical organization principles and fundamental mechanisms involved in the biological process. The potential topics include: Protein Folding, Protein Dynamics, Biomolecular Interactions and Recognition, Electron and Proton Transfer, Motors, Membranes, Single Molecules and Single Cells, Cellular Networks, Development and Differentiation, Brains and Neural Systems, Evolution. There will be no homework or exams. The grades will be based on the performance of the term projects. Crosslisted with PHY 680 and CHE 683.
0-3 credits, Letter graded (A, A-, B+, etc.)

AMS 690: Special Topics in Differential Equations and Applied Analysis
The course is designed for second- and third-year graduate students with a strong foundation in analysis who wish to pursue research in applied mathematics. Several topics may be taught concurrently in different sections.

3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

AMS 691: Topics in Applied Mathematics
Varying topics selected from the list below if sufficient interest is shown. Several topics may be taught concurrently in different sections: Advanced Operational Methods in Applied Mathematics Approximate Methods in Boundary Value Problems in Applied Mathematics Control Theory and Optimization Foundations of Passive Systems Theory Game Theory Mixed Boundary Value Problems in Elasticity Partial Differential Equations Quantitative Genetics Stochastic Modeling
0-3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

AMS 695: Special Topics in Numerical Analysis and Scientific Computing
Analysis and Scientific Computing
3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

AMS 696: Applied Mathematics Seminar
0-3 Credits, S/U Grading, May be repeated for credit.
0-3 credits, S/U grading
May be repeated for credit.

AMS 698: Practicum in Teaching
A practicum on teaching courses in applied mathematics and statistics. Topics may include designing a syllabus, planning lectures, developing assignments and assessments, coordinating and utilizing teaching assistants, monitoring for academic dishonesty, and using instructional technologies. Students will work with AMS instructors to both observe and practice teaching techniques.
S/U grading
May be repeated for credit.
AMS 699: Dissertation Research on Campus
Prerequisite: Must be advanced to candidacy (G5). Major portion of research must take place on SBU campus, at Cold Spring Harbor, or at the Brookhaven National Lab.
Fall, Spring, and Summer, 0-9 credits, S/U grading
May be repeated for credit.

AMS 700: Dissertation Research off Campus - Domestic
Prerequisite: Must be advanced to candidacy (G5). Major portion of research will take place off-campus, but in the United States and/or U.S. provinces. Please note, Brookhaven National Labs and the Cold Spring Harbor Lab are considered on-campus. All international students must enroll in one of the graduate student insurance plans and should be advised by an International Advisor.
Fall, Spring, 1-9 credits, S/U grading
May be repeated for credit.

AMS 701: Dissertation Research off Campus - International
Prerequisite: Must be advanced to candidacy (G5). Major portion of research will take place outside of the United States and/or U.S. provinces. Domestic students have the option of the health plan and may also enroll in MEDEX. International students who are in their home country are not covered by mandatory health plan and must contact the Insurance Office for the insurance charge to be removed. International students who are not in their home country are charged for the mandatory health insurance. If they are to be covered by another insurance plan they must file a waiver be second week of classes. The charge will only be removed if other plan is deemed comparable.
All international students must received clearance from an International Advisor.
Fall, Spring, 1-9 credits, S/U grading
May be repeated for credit.

AMS 800: SUMMER RESEARCH
May be repeated for credit.

ANT

Anthropology, Cultural and Archaeology

This course is one of five that constitute the Advanced Graduate Certificate in Human Origins at the Turkana Basin Institute in Kenya. With the world's longest sequence of datable deposits containing fossils of our ancestors, eastern Africa is the ideal place to examine humans' changing relations with our environment. This course familiarizes students with diverse ecological settings in the region today through field exercises in highland forests, low-altitude grasslands, and lacustrine and riparian settings. Students learn various methods for paleoenvironmental reconstruction, and practice integrating different kinds of paleoenvironmental evidence in field and laboratory facilities in Kenya. Examining modern vegetation and fauna in central and northwest Kenya shows students how human actions can degrade or conserve environments and resources in eastern Africa today.
3 credits, Letter graded (A, A-, B+, etc.)

ANT 505: Earth & Life Through Time: Vert Paleo (Turkana Basin)
This course is one of five that constitute the Advanced Graduate Certificate in Human Origins at the Turkana Basin Institute in Kenya. Vertebrate fossils are important sources of information about the appearance, evolution, and extinction of major organisms. As such, they provide a valuable window into changes in climate and selection pressures, and organisms' diverse adaptive responses to these changes. They are also significant in placing hominin discoveries within a relative local chronology and helping reconstruct environments associated with hominin remains. This course acquaints students with methods of vertebrate paleontology employed in different chronological contexts of the Turkana Basin and their use in addressing diverse theoretical questions.
3 credits, Letter graded (A, A-, B+, etc.)

ANT 506: Human Evolution and evidence from the Turkana Basin
This course is one of five that constitute the Advanced Graduate Certificate in Human Origins at the Turkana Basin Institute in Kenya. The Turkana Basin is home to many paleoanthropological discoveries that fundamentally reshaped ideas about human evolution. Important finds from the Turkana Basin, including Nariokotome (Turkana boy) and KNM-WT17000 (the ‘Black Skull’), will be highlighted in lecture and lab activities, and their relevance to the larger picture of human evolution will be explored. In addition to highlighting the key role that Turkana Basin fossils have played in human evolutionary studies, lectures, seminars, and labs will cover the complete span of our evolutionary history from Miocene apes and the earliest putative hominins to the evolution of modern humans. Field trips to discovery locations will provide students with the opportunity to understand the geological context of important fossils of the Turkana Basin.
3 credits, Letter graded (A, A-, B+, etc.)

ANT 507: Prehistoric Archaeology of Africa (emphasis Turkana Basin)
This course is one of five that constitute the Advanced Graduate Certificate in Human Origins at the Turkana Basin Institute in Kenya. Stone tools and other technologies enabled early hominins to become one of the few organisms that could purposefully change their environment to suit their needs, changing them from one among many African primates to the equivalent of a global geological force. This course traces the development of human technology where it first appears in Eastern Africa more than 3 million years ago. Course topics include the cognitive abilities of early humans implied by their technologies, early human adaptation and social behavior, and the inter-relationships between stone tool technology, paleoecology, and hominin biological evolution. Lectures and practical exercises teach students how to document the archaeological record and how to use it to test hypotheses about early human behavior. Field excursions teach archaeological survey and excavation techniques.
3 credits, Letter graded (A, A-, B+, etc.)

ANT 508: Paleoenthropological Field Methods in the Turkana Basin
This course is one of three that constitutes the Turkana Basin Institute Summer Field School, an opportunity to participate in all aspects of a paleoanthropological research project, focusing on practical aspects of vertebrate paleontology, geology, zooarchaeology and taphonomy. Students are trained in field reconnaissance, fossil survey, plotting, preservation, and collection, analysis and interpretation. Hands-on examination of fossils from Plio-Pleistocene or Holocene sites around Lake Turkana will teach students how human ancestors and other animals adapted to the environments around them. Experts from TBI, Stony Brook, and other institutions provide instruction in lectures, labs, and via fieldwork within the context of on-going projects.
3 credits, Letter graded (A, A-, B+, etc.)

ANT 510: Environments, Ecosystems and Evolution: Evidence from the Turkana Basin
An introduction to the ways scientists use the fossil and archaeological records to learn about past changes in Earth's climates and environments, and how humanity's ancestors
responded to those changes physiologically and technologically. Interdisciplinary lectures will show evidence from the Turkana Basin's paleoenvironmental, fossil and archaeological records of the dynamic interactions between the climate, environment, local food webs, and ancient human populations. This background will prepare students for training in paleoanthropological and archaeological field methods.

3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

ANT 513: Origins of Agriculture
This course will trace the history of anthropological thought on the origins of agriculture and will assess the evidence from the Old and New worlds for this economic revolution. The course will not only explore areas where early agriculture is evidenced, but will also contrast these areas with those where agriculture was a later development. Emphasis will be on the environmental, technological, biological, social, and cultural processes associated with the "Neolithic Revolution." This course is offered as both ANT 513 and DPA 513.

Fall, 4 credits, Letter graded (A, A-, B+, etc.)

ANT 514: Human Osteology
A detailed study of the anatomy of the human skeleton with special emphasis on the interpretation of skeletal remains from archaeological contexts. Consideration is given to the growth, structure, and function of bones, and to forensic aspects such as the determination of age, sex, stature, and pathology from skeletal remains. Students conduct a research project on a human skeleton.

3 credits, Letter graded (A, A-, B+, etc.)
May be repeated 2 times FOR credit.

ANT 515: Approaches in Archaeology
Theoretical and methodological approaches employed in archaeology. The goals of the course are to provide an historical perspective on the growth of theory and method in archaeology and to examine in detail some of the pertinent research topics being studied today. This course is offered as both ANT 515 and DPA 515.

Fall, 4 credits, Letter graded (A, A-, B+, etc.)

ANT 516: Research Design in Archaeology
An examination of the ways in which archaeologists develop successful research strategies for arriving at answers to the key questions in the field. Students will analyze grant proposals that received funding from the major sources of funding for archaeology before developing research proposals of their own. The aim of the course is to provide the class with the skills needed to plan their future and compete successfully for funding both for their thesis research and in their future careers.

Fall, alternate years, 3 credits, Letter graded (A, A-, B+, etc.)

ANT 518: Lithic Technology
A detailed overview of the methods archaeologists use to extract behavioral information from prehistoric stone tools. The course examines raw material economy, technological strategies, tool use, and discard behavior. Analytical methods are practiced through the computer-assisted analysis of stone tools from simulated archaeological sites.

Spring, 3 credits, Letter graded (A, A-, B+, etc.)

ANT 519: Zooarchaeology
An introduction to the study of animal bones from archaeological sites. Special emphasis is on identification of fragmented bone, identification of bone surface modification, calculation of indexes of abundance, and measurement and metrical analysis of mammal bone. Computer analysis is stressed, and the class seeks to synthesize traditional zooarchaeological and actualistic studies. This course is offered as both ANT 519 and DPA 519.

4 credits, Letter graded (A, A-, B+, etc.)

ANT 525: Research Areas in Anthropological Sciences
An overview of the current research areas of the Anthropological Sciences as represented in the Master's Program of the Department of Anthropology. All first-year students are expected to participate. Semesters offered: Fall 0-1 credits, S/U grading
May be repeated 1 times FOR credit.

ANT 527: Field Methods and Techniques in Archaeology
An opportunity to participate in all aspects of an archaeological research project. Students develop practical skills in excavation, and design and execute plans for recording, artifact retrieval, surveying, field sorting techniques, and interpretation. This course involves faculty-led excavation of a prehistoric or early historic site. This course is offered as both ANT 527 and DPA 527. Prerequisite: Graduate standing or permission of instructor
3-9 credits, Letter graded (A, A-, B+, etc.)

ANT 535: Ethnoarchaeology
Ethnoarchaeology uses observations of present-day peoples to inform archaeological inquiry. This course helps students to explore ways in which ethnoarchaeological data contribute to several aspects of archaeological research: hypothesis building, survey and excavation strategies, interpretation of site and artifact data, and understanding the causes and processes of human behavioral change. In addition to seminar discussions of theoretical issues and case studies, students complete a book review of a monograph-length ethnoarchaeological study, a practical exercise in collecting and interpreting ethnoarchaeological data, and a term paper.
4 credits, Letter graded (A, A-, B+, etc.)

ANT 536: Phylogenetic Comparative Methods for trait evolution
The course provides an overview of biostatistical approaches that are used to estimate phenotypic trait evolution and provides participants with a springboard to using these methods to answer their own research questions. This course focuses on analyses that use a phylogenetic tree and observed trait information from tip taxa (extant and/or extinct) to describe how traits have changed along the branches of a phylogeny. The course covers methods that account for phylogenetic relatedness in standard parametric tests and methods that use models of evolution to infer how traits have changed along branches of phylogeny. The course will involve substantial preparation and take-home assignments. Students will become proficient in R programming.
3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

ANT 555: Ancient African Civilizations
The archaeological of Africa’s later prehistoric and historic periods offers exciting contributions to global debates on the origins of agriculture and civilization. Covering the last 30,000 years, this course begins by examining the economic underpinnings of Africa’s early complex societies: intensive hunting & gathering, animal domestication, and early farming. Detailed case studies of five ancient civilizations (Egypt, Aksum, Jenne, Swahili, and Great Zimbabwe), and then explore distinct processes of prehistoric social change in different parts of Africa. The course concludes by discussing African archaeological heritage conservation, education and synthesis. Beyond these main themes, we develop additional units and discussions on topics of special interest to the students enrolled.

4 credits, Letter graded (A, A-, B+, etc.)
ANT 557: Building Bones: Bone Development and Evolution
An overview of the evolution, development, and growth of the skeleton, with a focus on mammals, primates, and humans. Students will review fundamental bone biology concepts, then read and discuss classic and current research on the evolution of bone development and the developmental basis for specific evolutionary changes in bone morphology. While much bone biology research has been completed in animal models, this course specifically builds a foundation for students to understand and critique current studies on the evolution and development of primate and human skeletal morphology. Within this context, students independently complete a literature review of the potential developmental and genetic basis for evolutionarily relevant variation of a skeletal phenotype, then propose research to help test these hypothetical relationships. Prerequisites: Instructor Consent
3 credits, Letter graded (A, A-, B+, etc.)

ANT 559: Archaeology of Food
Explores the archaeological study of food and foodways. The emphasis is on the social aspects of food, particularly its roles in past power structures, social relationships, conceptions of identity, ritual practices, and gender roles. Also covers the theoretical and methodological approaches archaeologists use to study food in the past.
Fall, alternate years, 3 credits, Letter graded (A, A-, B+, etc.)

ANT 560: Ancient Mesopotamia
An examination of the cultural history of Mesopotamia based on the archaeological, textual and art historical record. Focusing on the fourth through second millennia, this course investigates both the long term developmental process of this civilization, and ways to understand its settlement systems, urban structure, social and political organization, economic structure and the role played by religion.
Fall, alternate years, 4 credits, Letter graded (A, A-, B+, etc.)

ANT 564: Primate Evolution
The taxonomic relationships and evolutionary history of primates as documented by their fossil record and structural and chemical evidence. Emphasis on primates prior to the origin of the human lineage. This course is offered as ANT 564, DPA 564 and HBA 564.
4 credits, Letter graded (A, A-, B+, etc.)

ANT 565: Human Evolution
A survey of the fossil record of hominid evolution through the Pliocene and Pleistocene with emphasis on the morphological structure and function of locomotor, masticatory, and neural systems. Includes utilization of comparative anatomical material and an extensive cast collection. This course is offered as ANT 565, DPA 565 and HBA 565.
4 credits, Letter graded (A, A-, B+, etc.)

ANT 567: Primate Behavior and Ecology
A comparative approach to the behavior and ecology of living lemurs, monkeys, and apes. Emphasis is placed on sociobiological theory: life history strategies; morphological adaptations; comparisons of primate communities in Asia, Africa, Madagascar, and South America; and primate conservation. This course is offered as both ANT 567 and DPA 567.
Fall, odd years, 4 credits, Letter graded (A, A-, B+, etc.)

ANT 582: Comparative Primate Anatomy
The comparative anatomy of living primates. Laboratory work including evaluation of skeletal material and dissection (when possible) with emphasis on relating structural diversity to behavior and biomechanics. This course is offered as both ANT 582 and DPA 582.
4 credits, Letter graded (A, A-, B+, etc.)
May be repeated 2 times FOR credit.

ANT 591: Professional Skills in the Anthropological Sciences, I.
An overview of the skills necessary for scientific professionalism, with special reference to successful performance in the Anthropological Sciences. Topics covered in this course include: use of basic software tools, research design, data collection and management, dissertation proposal and journal article writing, oral and poster presentations, and professional conduct. This course is not an alternative to GRD 500. Recommended for students of G0 through G4 status. Permission by Instructor
0-3 credits, S/U grading

ANT 593: Ethics in the Anthropological Sciences
This course familiarizes students with the major issues in the ethics of anthropological science, research and teaching. Students discuss scientific and academic values and how best to comply with them in academic, field, and laboratory environments. Overarching research ethics topics addressed include data management, scientific misconduct, plagiarism, authorship, and mentoring. This portion of the course incorporates videos and readings from GRD 500. Anthropology-specific topics include fieldwork, museum work, animal research, US and international laws (biodiversity; cultural & natural heritage), and public anthropology. Anthropological Sciences faculty with particular expertise in these various areas lead these discussions.
0-1 credits, S/U grading
May be repeated for credit.

ANT 599: Capstone Project
Fall, 0-6 credits, S/U grading
May be repeated for credit.

ANT 600: Practicum in Teaching
A specialized tutorial in which students work with / shadow an instructor for a given course to learn pedagogy, and practical and professional skills with regard to classroom instruction. Instructor Consent
0-3 credits, S/U grading

ANT 602: Research Seminar in Anthropological Theory
This course is offered as both ANT 602 and DPA 602.
Fall and Spring, 0-12 credits, S/U grading
May be repeated for credit.

ANT 610: Individual Research
Research supervised by faculty. Students must have permission of instructor and enroll in appropriate section. This course is offered as both ANT 610 and DPA 610.
Fall and Spring, 1-12 credits, S/U grading
May be repeated for credit.
ANT 620: Research Seminar in Topical Problems
This course is offered as both ANT 620 and DPA 620.
Fall and Spring, 3 credits, S/U grading
May be repeated for credit.

ANT 630: Research Seminar in Physical Anthropology
This course is offered as both ANT 630 and DPA 630.
Fall and Spring, 3 credits, S/U grading
May be repeated for credit.

ANT 650: Research Seminar in Archaeology

ANT 680: Special Seminar
Selected topics in cultural and social anthropology. Topics reflect current interests of faculty and graduate students. This course is offered as both ANT 680 and DPA 680.
Fall and Spring, 1-3 credits, S/U grading
May be repeated for credit.

ANT 800: Summer Research
This course is offered as both ANT 800 and DPA 800.
S/U grading
May be repeated for credit.

ARH

Art History

ARH 503: History of 20th-Century Art Criticism and Theory
The literature of art has expanded enormously in the 20th century far beyond attempts to organize it developmentally or conceptually. An attempt is made to define types of criticism both in relation to the critics and their relation to the support system for the arts of which they are part.
Spring, 3 credits, Letter graded (A, A-, B+, etc.)

ARH 520: Media Aesthetics
In this seminar we will focus on a comparative approach to theories of visual media aesthetics across photography, cinema, and new media, from the nineteenth century to the present, and across disciplinary methods of art history, film studies, philosophy/critical theory, and media theory. Mixing canons and objects will allow a cross-fertilization of ideas and strategies for analyzing visual culture, and it should be useful for students working in a number of fields. This course will not offer a comprehensive survey as much as a close analysis of a body of related texts, ideas, and visual works. Students from any disciplinary background are welcome, and may adapt the final assignment to advance individual research goals. The selection of readings and examples we discuss will be adapted as the course unfolds. But, it is shaped by an interest in how/what media aesthetics can do or mean through the production of specific temporal and spatial forms of experience. This question has conditioned disciplinary formations, shaping canonical ideas about media in modernity as well as current interpretations of digital media. But it remains urgent to re-ask: how do, and how could, aesthetics and technics correlate with actual embodied and sociopolitical realities? How do specific material formats, specific practices of perception, and specific historical and cultural contexts interweave with and impact more abstract ontological, phenomenological, epistemological, and ethical potentials?
3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

ARH 521: Global Postwar Art
This course has a two-fold goal: to explore the recent scholarship on postwar art across a spectrum of situated geopolitics; and to explore the year 1989 in global exhibition contexts. In the semester's first half, the primary texts are by:onal Khullar, Worldly Affiliations: Artistic Practice, National Identity, and Modernism in India, 1930-1990 (2015), Christine Ho, Drawing from Life: Sketching and Socialist Realism in the People's Republic of China (2020), and Joshua Cohen, The Black Art Renaissance: African Sculpture and Modernism across Continents (2020).2 are paired with a range of articles and book chapters written by more established scholars in the relevant subfields. As we will learn, the temporal demarcation of the year 1945 is not strictly observed in this representation of recent scholarship. In the semester's second half, the students will explore a case study of their choice, the 3rd Havana Bienal (Havana, 1989), Les Magiciens de la Terre (Paris, 1989), The Other Story (London, 1989), and The Decades Show (New York, 1990), by conducting research of both primary and secondary literature. Each of these exhibitions manifest a particular picturing of the global, allowing us to trace multiple swan songs of the global postwar period.
3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

ARH 540: Methodologies of Art History
This graduate seminar is designed to engage students with the history and methods of the discipline of art history. Through close readings and focused discussions, the course examines issues raised by aesthetics, the problems of biography and ‘periodization’, and the role of canon formation. Particular focus is directed towards the interpretive tools that have developed from within the discipline of art. In addition, also stressed is the interdisciplinary nature of art history through readings that discuss how lines of thought and critical inquiry emerging within other disciplines have had enormous influence on art history and criticism in the last two decades: semiotics, feminist theory, psychoanalysis, anthropology and post colonial theory, cultural studies, theories of mass culture and the post-modern, and the current debates about visual culture.
3 credits, Letter graded (A, A-, B+, etc.)

ARH 543: Topics in Renaissance Art
This course, usually a seminar, deals with one or several of the following aspects of Renaissance art: iconographic problems, style and connoisseurship (including the study of individual works at the Metropolitan Museum or the Frick), patronage and its effect on the form and content of a work, the exchange of artistic ideas between northern and southern Europe, and Renaissance sources in antiquity and the Middle Ages.
Fall or Spring, alternate years, 3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

ARH 544: Topics in Early Modern Art
This seminar examines methodological developments and historical issues related to the art and visual culture of the early modern period. Though we are concerned with objects, discourses, and practices emerging in the seventeenth century, we also approach these through the perspective of contemporary critical tools (for example, theories of urban space, spectacle, and representation; psychoanalysis, sexuality and subjectivity; coloniality and the encounter with New world otherness; semiotics and the construction of absolutist power). Students are encouraged to engage with these issues through the study of traditional high art objects as well as through other forms of representation emerging in the early modern period—for example, scientific illustration, more ephemeral forms of print culture, and even urban and courtly spectacle.
Fall or Spring, alternate years, 3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

ARH 545: Topics in 19th-Century Art
Selected topics in 19th-century art with an emphasis on...
ARH 546: Topics in 20th-Century Art
Twentieth-century art considered as an international movement, European and American, although national groups may be studied. Emphasis varies with topics ranging over stylistic analysis, iconographical interpretations, and theoretical studies. Students are expected to undertake original research and interpretation.
Fall or Spring, alternate years, 3 credits, Letter graded (A, A-, B+, etc.) May be repeated for credit.

ARH 547: Topics in Global, Colonial, and Diasporic Art
This course examines various issues in the appreciation, interpretation and appropriation of non-Western art. Emphasis is on developing a critical approach to these arts and the manner in which they have been represented and misrepresented in the Western imagination. Topics vary, but may include exploration of themes in the so-called traditional arts of Africa, Oceania, Native and Latin America, the transformations of these arts during the colonial period, issues of identity and the consequences of dislocation versus sense of place in the diaspora, and contemporary expressions of non-Western artists on the global scene.
Fall or Spring, alternate years, 3 credits, Letter graded (A, A-, B+, etc.) May be repeated for credit.

ARH 548: Museum Studies
Through a combination of field trips, visiting lecturers, group discussion, and student projects, the course surveys the diverse aspects of the museum field, including management, curatorship, exhibitions, public relations, conservation, and other areas of administration and professional practice.
3 credits, Letter graded (A, A-, B+, etc.)

ARH 549: Topics in American Visual Culture
This course examines selected issues in the history of American art and material culture. The course focuses upon, but is not necessarily limited to, the United States. Topics include public art and public culture; approaches to the study of material culture; art and commercial and/or popular culture; art and regional locations; realism; imaging the West; cross-cultural exchanges in art of the United States. (May be used to fulfill 20th-century requirement when material deals with 20th-century art.)
Fall or Spring, alternate years, 3 credits, Letter graded (A, A-, B+, etc.) May be repeated for credit.

ARH 550: Inquiries into Art Criticism and Theory
This course deals with the theoretical approaches to the study of art that cross historical boundaries. Topics vary from semester to semester. They may be an expansion of one of the areas generally covered in ARH 540, such as psychology of art or the iconography of architecture. Other investigations may focus on subjects requiring a special methodological approach, such as the history and theory of ornament and design or the role of public art.
Fall or Spring, 3 credits, Letter graded (A, A-, B+, etc.) May be repeated for credit.

ARH 551: Topics in Performance
The histories and theories of performance are explored. Topics may be the performing body, performance and political action, avant-garde performance, performing and artifact, virtual performance, performance and identity. Depending on the topic, there may be a performance and/or computer based projects.
3 credits, Letter graded (A, A-, B+, etc.)

ARH 552: Topics in Contemporary Art
The course will examine the latest developments in visual art and architecture, beginning with the Neo-Expressionism and Neo-Conceptualism of the 1980s and extending to installation and video art. Postmodernist and activist art will be examined in particular detail, and contextualized in terms of the broader patterns of 20th century art.
3 credits, Letter graded (A, A-, B+, etc.) May be repeated 2 times FOR credit.

ARH 553: Contemporary Art in New York
A systematic survey of contemporary art on view in museums and galleries in New York. The class would alternate between gallery/museum visits and interpretative analyses of the work in the classroom. A variety of theoretical approaches will be used and the full range of contemporary pluralism will be examined. Contemporary art will be understood as both a manifestation of contemporary society and in terms of its larger art historical context and significance. The New York art scene is the richest in the world. The class offers the student the opportunity for direct, informed contact with it.
3 credits, Letter graded (A, A-, B+, etc.)

ARH 554: Topics in Visual Culture
This class examines issues in the interdisciplinary field of visual culture. Visual culture studies look at the dynamic state of visual media in contemporary life and their historical origins, seeking to relate art and film to the mass media and digital culture.
Fall or Spring, 3 credits, Letter graded (A, A-, B+, etc.) May be repeated for credit.

ARH 555: Inquiries into Art Criticism
This course deals with the theoretical approaches to the study of art that cross historical boundaries. Topics vary from semester to semester. They may be an expansion of one of the areas generally covered in ARH 540, such as psychology of art or the iconography of architecture. Other investigations may focus on subjects requiring a special methodological approach, such as the history and theory of ornament and design or the role of public art.
Fall or Spring, 3 credits, Letter graded (A, A-, B+, etc.) May be repeated for credit.

ARH 556: Issues in Architectural History and Criticism
This course examines a series of topics that link architecture with other critical disciplines. Among the topics that may be addressed are architectural theory and the theories of language; the history of proportion and the construction of gender; and Orientalism.
Fall or Spring, alternate years, 3 credits, Letter graded (A, A-, B+, etc.) May be repeated for credit.

ARH 557: Art Criticism or Gallery Internship
An internship offering practical experience in some aspect of the field of art history and criticism, such as gallery and curatorial work in an on-campus or off-campus gallery or museum, or journalistic experience with an art or criticism publication such as the Art department journal Art Criticism.
Prerequisite: Good standing in the graduate art history and criticism program
Fall and Spring, 1-3 credits, S/U grading May be repeated 2 times FOR credit.

ARH 558: Art Criticism or Gallery Internship
An internship offering practical experience in some aspect of the field of art history and criticism, such as gallery and curatorial work in an on-campus or off-campus gallery or museum, or journalistic experience with an art or criticism publication such as the Art department journal Art Criticism.
Prerequisite: Good standing in the graduate art history and criticism program
Fall and Spring, 1-3 credits, S/U grading May be repeated 2 times FOR credit.

ARH 559: Practicum in the Writing of Art Criticism
This course is designed as a practicum in the writing of art criticism under the supervision of the faculty.
Fall and Spring, 3 credits, S/U grading May be repeated 2 times FOR credit.

ARH 560: Practicum in Teaching
Instruction in the department under the supervision of the faculty. (This course may not be included more than once in the courses
taken in fulfillment of the 36 credit hour requirement.)

Fall and Spring, 3 credits, S/U grading

ARH 595: Directed Readings in Art History, Criticism, and Theory

An independent reading course to be arranged with a particular faculty member. Normally, this course is reserved for second year Masters Students who have fulfilled most of their course requirements and for whom the proposed program of study cannot be completed within other existing course structures.

Fall and Spring, 1-3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

ARH 598: Thesis

Prerequisite: Completion of all degree requirements Fall, Spring and Summer, 1-6 credits, S/U grading
May be repeated for credit.

ARH 602: Teaching Practicum, Advanced

Instruction in the department by advanced graduate students under the supervision of faculty.
3 credits, S/U grading
May be repeated 2 times FOR credit.

ARH 690: Directed Readings for Doctoral Candidates

An independent reading course to be arranged with a particular faculty member. Normally, this course is reserved for advanced PhD. students who have fulfilled most of their course requirements and for whom the proposed program of study cannot be completed within other existing course structures.

Fall and Spring, 1-9 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

ARH 699: Dissertation Research on Campus

Major portion of research will take place on SBU campus, at Cold Spring Harbor, or at the Brookhaven National Lab.
Fall, Spring, and Summer, 1-9 credits, S/U grading
May be repeated for credit.

ARH 700: Dissertation Research off Campus - Domestic

Prerequisite: Must be advanced to candidacy (G5). Major portion of research will take place off-campus, but in the United States and/or U.S. provinces. Please note, Brookhaven National Labs and the Cold Spring Harbor Lab are considered on-campus. All international students must enroll in one of the graduate student insurance plans and should be advised by an International Advisor.

Fall, Spring, 1-9 credits, S/U grading
May be repeated for credit.

ARH 701: Dissertation Research off Campus - International

Major portion of research will take place outside of the United States and/or U.S. provinces. Domestic students have the option of the health plan and may also enroll in MEDEX. International students who are in their home country are not covered by mandatory health plan and must contact the Insurance Office for the insurance charge to be removed. International students who are not in their home country are charged for the mandatory health insurance. If they are to be covered by another insurance plan they must file a waiver be second week of classes. The charge will only be removed if other plan is deemed comparable.

All international students must received clearance from an International Advisor.

Fall, Spring, 1-9 credits, S/U grading
May be repeated for credit.

ARH 800: Summer Research

May be repeated for credit.

ARS

Art, Studio

ARS 520: Special Projects for M.F.A. Candidates

Advanced projects in areas that may not be included in the M.F.A. curriculum, utilizing the unique talents of regular and visiting faculty, the facilities of the Art department, or other aspects of the university environment, and possibly facilities at other locations or institutions. This course has an associated fee. Please see www.stonybrook.edu/coursefees for more information.

Prerequisites: Faculty sponsor, permission of graduate studies director.

Fall, Spring and Summer, 1-9 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

ARS 525: Electronic Media

An exploration of the experimental artistic practices utilizing computer and electronic technologies: digital imaging, video and audio, web and CD-Rom production, and interactive installation. It will provide practical instruction in the use of computer media with an orientation towards relating this to the graduate student’s own practice. It will also analyze the unique possibilities of this hybrid and developing art form through theoretical readings and examination of recent works, exhibitions, festivals, and the worldwide web.

This course has an associated fee. Please see www.stonybrook.edu/coursefees for more information.

Prerequisite: Accepted candidate for M.F.A.
or permission of department

Fall and Spring, 3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

ARS 530: Professional Experience Internship

Internship in the professional art world of New York City and its environs. Depending on the career objectives of the M.F.A. candidate, the student may choose to intern at a foundry, printmaking atelier, art gallery or museum, known artist’s studio, or related facility or institution.

Prerequisite: Accepted candidate for M.F.A.

Summer, 1-3 credits, S/U grading
May be repeated 2 times FOR credit.

ARS 531: Graduate Teaching Practicum

Supervised teaching practicum in undergraduate studio or studio, theory course.

Prerequisite: Accepted candidate for M.F.A.

Fall and Spring, 1-3 credits, S/U grading
May be repeated 2 times FOR credit.

ARS 532: Thesis Project

Preparation of thesis under the program advisor.

Prerequisites: Accepted candidate for M.F.A., review board passed

Summer, 1-6 credits, S/U grading
May be repeated for credit.

ARS 535: Projects in Studio Art

Projects in studio art, field and media to be determined on a per semester basis by the individual instructor.

1-6 credits,
May be repeated 2 times FOR credit.

ARS 540: Graduate Photo Studio

Photographic studio, theory, and laboratory emphasizing individual development as a photographer. Color and black-and-white studios and darkrooms. Fine arts, reportage, illustration, commercial, and industrial. This course has an associated fee. Please see
ARS 550: In Process Critique
Graduate theory and practice of art, investigating historical and contemporary concepts, concentrating on individual development as an artist. Conceptual, environmental and wide ranging solutions are encouraged. Required for first year MFA’s, this course culminates in a body of work for the end of the year First Year Exhibition. The course also provides students with vigorous critical feedback throughout this process, augmenting it with readings and discussions of related New York City exhibitions in galleries and museums to inform the development of their work.

Spring, 3 credits, Letter graded (A, A-, B+, etc.)

May be repeated for credit.

ARS 551: Graduate Painting Studio
Studio and theory in painting and related visual forms, with instruction and facilities available in all media and techniques; emphasis on individual development as an artist. Models and space for environmental and conceptual works available. This course has an associated fee. Please see www.stonybrook.edu/coursefees for more information.

Prerequisites: Permission of instructor; accepted candidate for M.F.A. or permission of department

Fall and Spring, 3 credits, Letter graded (A, A-, B+, etc.)

May be repeated for credit.

ARS 552: Advanced Laboratory Methods in Biochemistry and Cell Biology
This course introduces theoretical principles and experimental techniques used to investigate the properties of biological molecules and their interactions. Students will familiarize themselves with the instrumentation and techniques used to investigate different biochemical and cell biological problems through a combination of lectures and demonstrations. Various topics will be covered such as protein purification and characterization using spectroscopic and thermodynamic techniques as well as gel electrophoresis and immunoblotting; identification of metabolites by mass spectrometry; bioinformatics analysis of DNA deep sequencing data; electron and fluorescence microscopy and the use of zebrafish and nematodes to understand biological processes.

3 credits, Letter graded (A, A-, B+, etc.)

ARS 560: Graduate Sculpture Studio
Theory and practice of sculpture for the graduate student, with instruction and facilities available in all media and techniques; emphasis on individual development as an artist. Studio facilities include air, electric, and hydraulic power equipment; TIG, MIG, Arc, and flame welding; forging; woodworking; modeling, molding, and casting facilities for clay, wax, plaster, and plastics; and metal casting capabilities in investment, shell, sand, and centrifugal. This course has an associated fee. Please see www.stonybrook.edu/coursefees for more information.

Prerequisites: Permission of instructor; accepted candidate for M.F.A. or permission of department

Fall and Spring, 3 credits, Letter graded (A, A-, B+, etc.)

May be repeated for credit.

ARS 561: Graduate Ceramics and/or Ceramic Sculpture Studio
Theory and practice of ceramics and ceramic sculpture for the graduate student with emphasis on individual development as an artist. Advanced studio instruction in handbuilding: coil, slab, pinch; wheelthrowing; casting, inclusive of multipiece plaster pour-molds; various firing techniques: reduction, oxidation, raku, and high- and low-fire glaze techniques. This course has an associated fee. Please see www.stonybrook.edu/coursefees for more information.

Prerequisites: Permission of instructor; accepted candidate for M.F.A. or permission of department

Fall and Spring, 3 credits, Letter graded (A, A-, B+, etc.)

May be repeated for credit.

ARS 570: Graduate Printmaking Studio
Graduate studio in the theory and practice of printmaking. Color, black-and-white, and photographic processes in plate and stone lithography, serigraphy, relief, and intaglio, emphasizing the student’s individual development as an artist.

Prerequisites: Permission of instructor; accepted candidate for M.F.A. or permission of department

Fall and Spring, 3 credits, Letter graded (A, A-, B+, etc.)

May be repeated for credit.

ARS 580: Visual Arts Seminar
Required seminar and critique throughout the M.F.A. curriculum. Guest speakers, artists, and critics; demonstrations and lectures; seminars; individual and group critiques. The M.F.A. candidate, as part of this seminar, regularly participates in critiques in which his or her work is analyzed by guest faculty and art history/criticism faculty and graduate students, as well as by his or her peers. The visual arts seminar, where applicable, includes field trips and assignments of special lectures, panels, seminars, and other events of the professional art world.

Fall and Spring, 3 credits, Letter graded (A, A-, B+, etc.)

May be repeated for credit.

ARS 800: Summer Research

BCB

BCB 551: Introduction to Research in Biochemistry and Cell Biology
A series of talks, discussions, and practical exercises to address topics related to research in biochemistry and cell biology including laboratory etiquette, the laboratory notebook, experimental design, critical evaluation of the literature, analysis and presentation of data, ethical issues, and basic experimental techniques used in biochemistry and cell biology.

Prerequisites: Matriculation in MS program or permission of instructor

Fall, 2 credits, Letter graded (A, A-, B+, etc.)

BCB 559: MS Thesis Research in Biochemistry and Cell Biology
The student will be introduced to modern biochemical and cell biological research techniques through participation in ongoing research in the laboratory of a Biochemistry and Cell Biology or associated faculty member for one semester. Student must obtain permission to register from the sponsoring faculty member.

Prerequisite: Matriculation in MS program or permission of instructor

Fall, Spring, and Summer, 0-4 credits, S/U grading

May be repeated for credit.

BCB 559: MS Thesis Research in Biochemistry and Cell Biology
Thesis research will be conducted in the laboratory of a Biochemistry and Cell Biology or associated faculty member, including potentially an internship under the guidance
of an approved mentor in the laboratory of a local biotechnology company. Student must identify and obtain permission to register from the sponsoring faculty member. Prerequisite: Matriculation in MS program or permission of instructor Offered

Fall, Spring, and Summer, 3-6 credits, S/U grading

BDA

Decision Analytics

BDA 503: Data Analysis & Decision Making
An introduction to statistical techniques useful in the analysis of management problems. We motivate each topic by managerial applications, and we analyze actual data sets using modern statistical software. Topics include probability estimation, hypothesis testing, and regression analysis. 3 credits, Letter graded (A, A-, B+, etc.) Prerequisite: Admission to the BDAMS or MS in Decision Analytics
3 credits, Letter graded (A, A-, B+, etc.)

BDA 508: Advanced Analytics
This course introduces students to challenging business problems in distribution, routing and scheduling, and to the solutions strategies for such problem via discrete optimization. The topics include integer programming techniques such as cutting plane and branch and bound, special purpose algorithms for distribution and network problems, and heuristic optimization techniques for combinatorial optimization, such as Simulated Annealing, Tabu Search, Evolutionary Algorithms, Ant Colony Optimization. Prerequisite: MBA 543
3 credits, Letter graded (A, A-, B+, etc.)

BDA 513: Risk and Uncertainty Analysis
This is a hands-on course on computer simulation and other probabilistic modeling approaches to analyze and improve business, service, and manufacturing systems that are subject to risk. The course takes the perspective of the consultant whose job is to analyze managerial decision based on imperfect observations and unknown outcomes to understand the behavior of the system and explore the effects of alternative decisions. Prerequisite: MBA 503
3 credits, Letter graded (A, A-, B+, etc.)

BDA 540: Data Mining for Business Intelligence
The recent advances in the Internet and information technologies have resulted in an explosion of demand for big data analytics. The importance of data mining has already been recognized widely in the industry including many business areas, such as marketing science, financial analysis, and corporation management. In this course, we will be focusing on both key concepts and models of data mining and their implementations based on real-world data in business. Students will learn to process data using Excel, and apply data mining models using Weka, a data mining software. 3 credits, Letter graded (A, A-, B+, etc.) Prerequisite: Admission to the BDAMS or MS in Decision Analytics & BDA 503
3 credits, Letter graded (A, A-, B+, etc.)

BDA 543: Business Analytics
An introduction to mathematical models useful in the analysis of management problems. We motivate each topic by managerial applications, and we analyze problems using modern software. Topics include forecasting, linear, nonlinear, and integer optimization, simulation, Markov processes, decision analysis, and multi-criteria decision making. 3 credits, Letter graded (A, A-, B+, etc.) Prerequisite: Admission to the BDAMS or MS in Decision Analytics & BDA 503 prerequisite/corequisite
3 credits, Letter graded (A, A-, B+, etc.)

BDA 587: Decision Support Systems

BDA 588: Database Management
Database processing is the foundation upon which all current applications rely and represent the repositories of business intelligence that play a crucial role in the strategic success or failure of a corporation. Even though they vary in size, complexity and organizational scope, there is an underlying common database engine that can be used to manipulate and analyze the stored information. The purpose of this course is to introduce the business professional to the fundamental concepts of database creation, design, application integration, maintenance, management, and subsequent analysis. 3 credits, Letter graded (A, A-, B+, etc.) Prerequisite: Admission to the BDAMS or MS in Decision Analytics
3 credits, Letter graded (A, A-, B+, etc.)

BEE

Ecology and Evolution

BEE 500: Directed Readings in Population Biology
Directed readings in topics of current interest, under supervision of a faculty sponsor, culminating in one or more critical review papers.
Prerequisites: Sponsor and approval of master's program executive committee
Fall and Spring, 1-3 credits, S/U grading
May be repeated for credit.

BEE 501: Directed Readings in the Biology of Organisms
Directed readings in topics of current interest, under supervision of a faculty sponsor, culminating in one or more critical review papers.
Prerequisites: Sponsor and approval of master's program executive committee
Fall and Spring, 1-3 credits, S/U grading
May be repeated for credit.

BEE 510: Biology Education Research: Teaching, Learning, and Assessment
Introduction to core policy documents, standards, concepts, and empirical methods in biology education research and their applications to undergraduate classroom settings. Appropriate for graduate students in the biological sciences and/or those enrolled in the Ph.D. Program in Science Education.
3 credits, Letter graded (A, A-, B+, etc.)

BEE 520: Advanced Human Genetics
An advanced course in human genetics. Topics include the genotype/phenotype association, genetic architecture of disease/phenotype, human population genetics, coalescent theory, methylation, and ancient DNA. The course will emphasize hands-on engagement with genetic data and critical reading of scientific papers. Computer laboratory analysis/assignments will make up a major component of this class. Students will be evaluated based
on computer assignments and a final individual research project.

Spring, 3 credits, Letter graded (A, A-, B+, etc.)

**BEE 521: Genomics Lab**

This course provides a computer lab-based introduction to comparative genomics, molecular evolutionary analysis, and next generation sequencing (NGS) data and analysis. Activities will include familiarization with both web-based and command-line tools for analyzing genomic data and summarizing/visualizing results. Lectures and background reading will provide an introduction to basic principles of genomics to inform computer-based hands-on activities. A weekly recitation will promote discussion. Students will be evaluated based on computer lab assignments, as well as a final individual project that applies learned concepts and approaches to a novel research question.

Spring, 3 credits, Letter graded (A, A-, B+, etc.)

**BEE 550: Principles of Ecology**

Population dynamics, interactions of organisms, theoretical concepts of community structure and their biological and evolutionary implications.

Prerequisite: Permission of instructor
Fall, 4 credits, Letter graded (A, A-, B+, etc.)

**BEE 551: Principles of Evolution**

Biological evolution, including the genetics of populations, speciation, evolution of higher taxa, and the fossil record.

Fall, 4 credits, Letter graded (A, A-, B+, etc.)

**BEE 552: Biometry**

An intensive course in statistical theory and methodology. The analysis of real biological data is emphasized. Topics include analysis of variance, simple multiple and curvilinear regression analysis, correlation analysis, and goodness of fit tests.

Spring, 4 credits, Letter graded (A, A-, B+, etc.)

**BEE 553: Multivariate Analysis in Biology**

An introduction to multivariate statistical analysis for biologists. Topics include general least squares analysis, MANOVA, cluster analysis, and factor analysis.

Prerequisite: BEE 552 or equivalent
Fall, 3 credits, Letter graded (A, A-, B+, etc.)

**BEE 554: Population Genetics and Evolution**

A general introduction to mathematical population genetics and evolutionary theory. The effects of mutation, recombination, selection, and migration are studied. Modern concepts in both theoretical and experimental population genetics are covered.

Prerequisite: BEE 552 or equivalent, and a course in evolution
Spring, odd years, 0-3 credits, Letter graded (A, A-, B+, etc.)

**BEE 555: Mathematical Methods in Population Biology**

This course covers a variety of mathematical methods used in modern theoretical biology. Topics include linear algebra and applications, ordinary and partial differential equations, and stochastic processes. Examples from population biology, i.e., mathematical ecology and population genetics, are used throughout.

Fall, even years, 3 credits, Letter graded (A, A-, B+, etc.)

**BEE 556: Research Areas of Ecology and Evolution**

A description of the current research areas of ecology and evolution, broadly conceived. All first-year ecology and evolution students are expected to participate.

Fall and Spring, 1-2 credits, S/U grading
May be repeated for credit.

**BEE 558: Tutorial Readings**

Individual tutorial study with an instructor in the Graduate Program in Ecology and Evolution for the purpose of background reading in an area of ecology and evolution.

Fall and Spring, 1-4 credits, S/U grading
May be repeated for credit.

**BEE 559: Individual Studies in Organisms**

A detailed study of the biology of a selected systematic group chosen by the graduate student and a faculty member. This is conducted as a tutorial course.

Fall and Spring, 1-4 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

**BEE 560: Advanced Ecology**

This course will provide students with an understanding of the theoretical basis and empirical tests of diverse advanced topics in the field of ecology. The format includes both lectures and student-led discussions of primary literature.

2 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

**BEE 562: Concepts and Methods in Evolutionary Biology**

The course aims at achieving two related objectives: first, to provide graduate students in Ecologic and Evolution, other biology departments, as well as Philosophy, with a basic understanding of the varied methods (both experimental and statistical) that make up the body of evolutionary quantitative biology. The focus will be in particular on quantitative genetics and its interface with more modern approaches, including QTL mapping, bioinformatics and the various "omics" (genomics, proteomics, etc.). Second, students will become familiar with the fundamental concepts of philosophy of science, in particular as they relate to the conceptual analysis of the ideas that shape modern evolutionary and ecological theory. In this respect, the focus will be both on philosophical concepts such as falsificationism, induction, deduction, hypothesis testing and the nature of evidence, as well as on the meaning of key ideas in evolutionary ecology, like natural selection, genetic drift, and constraints.

3 credits, Letter graded (A, A-, B+, etc.)

**BEE 564: Geometric Morphometrics**

An introduction to theory and methods used in geometric morphometrics. Image analysis, outline methods, landmark methods, and shape statistics are covered.

Prerequisite: BEE 552 or equivalent; BEE 553 recommended
Fall, even years, 3 credits, Letter graded (A, A-, B+, etc.)

**BEE 566: Horizons in Ecology and Evolution**

The course is designed to provide beginning graduate students in Ecology and Evolution with an extended perspective on current and developing trends in this field. It will be based on readings (empirical and review papers) and discussion on diverse topics. The hour-long class will meet on a weekly basis. Each class session will be led by the faculty member with expertise in the scheduled topic of study.

Offered:
Spring, 1 credit, S/U grading

**BEE 567: Molecular Diversity Laboratory**

This course will provide hands-on experience in established and recently developed methods of detecting and analyzing molecular variation (DNA, RNA, Proteins) in nature. Natural populations of Drosophila melanogaster will be the model material for this laboratory. The main theme of this course is that molecular...
variation is abundant in nature and is an important tool for understanding adaptive evolution and species relationships.

Prerequisite: permission of instructor
Fall, 3 credits, Letter graded (A, A-, B+, etc.)

BEE 569: Bayesian Data Analysis and Computation
An applied course in Bayesian analysis and hierarchical modeling for advanced graduate students in Ecology & Evolution or related sciences. Topics will include probability theory, Bayesian analysis, and MCMC methods such as Gibbs, sampling and Metropolis-Hastings sampling, as well as applied issues regarding the choice of prior distributions, posterior convergence, censored and missing data, and model checking and comparison. The course will be taught using WinBUGS and JAGS as accessed via the R packages R2WinBUGS and R2jags, respectively. Offered in the Fall.
4 credits, Letter graded (A, A-, B+, etc.)

BEE 571: Ecology Laboratory
This course stresses the collection, analysis, and interpretation of ecological data, mostly in terrestrial settings. Laboratory and field exercises demonstrate the operation of general ecological principles in specific populations and communities.
Fall, 3 credits, Letter graded (A, A-, B+, etc.)

BEE 572: Conservation Biology
Society and individual lives are increasingly affected by environmental degradation at different scales. From the decline of local fisheries to global climate change, multiple crises threaten the biodiversity and ecosystems that sustain us humans. This course introduces the scientific foundations of conservation biology, along with examples from real-world conservation. The course reviews the biological concepts that underlie conservation including habitat requirements, population dynamics, biogeography, and population genetics. Analysis of case studies on the effects of human activities on biological diversity and ecosystem services will be used to explore the interdisciplinary nature of the practice of conservation. This course will prepare students for careers in environmental sciences and ecology.
Offered in Spring, 3 credits, Letter graded (A, A-, B+, etc.)

BEE 574: Landscape Ecology Laboratory
A computer lab course focusing on spatial concepts, methods, and tools for addressing environmental problems. The course will be based on fundamental concepts in ecology and environmental science and extend that knowledge, as well as teaching technical skills, including the use of geographic information systems (GIS) software, image processing, spatially explicit modeling, and spatial statistics. The lab exercises will introduce a variety of spatial approaches for addressing problems in environmental protection, ecotoxicology, natural resource management, conservation biology and wildlife management.
Offered in Fall, 3 credits, Letter graded (A, A-, B+, etc.)

BEE 575: Evolutionary Ecology
The approach is to understand the theoretical basis and review empirical tests of diverse topics. The format includes both lectures and student-led discussions of primary literature.
Prerequisite: BEE 550; BEE 551, or permission of instructor
Fall, alternate years, 3 credits, Letter graded (A, A-, B+, etc.)

BEE 576: Principles and Applications of Ecology and Evolution
An overview of the principles of ecology and evolutionary biology, and the applications of these principles in conservation biology, environmental and health sciences, and resource management. The course will cover fundamental concepts and research questions in population, community, and ecosystem ecology; population genetics; and evolutionary ecology. These principles will be discussed in the context of contemporary issues, such as global climate change, biodiversity loss, environmental contaminants, infectious diseases, invasive species, and management of ecological resources.
Offered in Fall, 4 credits, Letter graded (A, A-, B+, etc.)

BEE 577: Ecological Genetics
An introduction to the concepts, research questions, and methods involved in modern ecological genetics and genomics. The course will provide a strong foundation and broad conceptual framework for students planning to engage in empirical work in conservation, management, ecology, and evolutionary biology. The course will cover basic Mendelian genetics, meiosis, and mating systems, standard population genetics methods for describing variation within and between populations, basic quantitative genetics, methods for molecular marker genotyping, bioinformatic and genomic concepts, and organism-specific methods and case studies, including plant and animal ecological genetics.
3 credits, Letter graded (A, A-, B+, etc.)

BEE 583: Paleobiology
Fossils are a fundamental component of the rock record and provide the only direct evidence of past life on Earth. They provide basic information for both geologists and biologists on topics like climate change, tectonic plate motion, the evolution of biological novelty, the nature of mass extinction, and the history of biodiversity. They are also increasingly used to establish natural baselines to inform modern conservation efforts. This course represents a process and systems-based study of the marine and terrestrial fossil record. The course will focus on preservation and taphonomy, macroevolution, biogeosciences, paleoecology, ecomorphology, biogeography, and the extinction of biotas in the context of the environmental history of Earth. The course format consists of a mix of lecture, discussion, and lab activities. This course will additionally take advantage of connections with the Turkana Basin Institute here at Stony Brook University, where researchers play an important role in understanding the evolution and paleoecology of East African ecosystems, including that of our own ancestors.
3 credits, Letter graded (A, A-, B+, etc.)

BEE 584: Intermediate Statistics
This is an intermediate-level course in biostatistics, emphasizing the use of statistics as a tool to answer scientific questions in ecology and other biological disciplines. Topics from introductory statistics courses will be explored in greater depth using the R software package. Additional advanced topics will include experimental design, metaanalysis, general linear models, complex regression, multifactar analysis of variance, and multivariate analyses. Within each topic, the assumptions of statistical tests will be examined, as well as methods to cope with violations of those assumptions. Students will develop skills in graphical display of quantitative data, exploratory data analysis, and critical evaluation of published statistical analyses. Students will use R software throughout the course to develop their coding skills.
3 credits, Letter graded (A, A-, B+, etc.)

BEE 585: Research Design and Analysis in Ecology and Evolution
This course covers topics relevant to statistical aspects of carrying out research in ecology and evolution as well as interpreting the results of one's own and others analyses, particularly in field data and for experimental data in the lab and field. The topics include
BEE 586: Introduction to Ecological Modeling

This course will provide students with a familiarity of the major concepts, approaches, and underlying rationale for modeling in the ecological sciences. Topics will include reviews of theoretical and empirical models, the use of models in adaptive management, and how to confront models with data to evaluate alternative hypotheses. Roughly 1/3 of the course will be devoted to the use of models in management, focusing on the problems of fitting models to data and management pitfalls that follow. Course work will consist of readings, in class exercises, and group assignments that involve the construction, analysis, and interpretation of ecological models.

Prerequisite: BEE 550, BEE 552; MAT 131 or equivalent; any statistics course.
Spring, 3 credits, Letter graded (A, A-, B+, etc.)

BEE 587: Applied Ecology and Conservation Biology Laboratory

A computer laboratory course introducing students to ecological risk analysis and conservation biology. Laboratories are based on interactive software. Computer simulation techniques for addressing problems in applied ecology are emphasized. This course is co-scheduled with BEE 353 for Spring 2012.
Prerequisite: A year of calculus; one-year undergraduate biology course for majors
Spring, even years, 3 credits, Letter graded (A, A-, B+, etc.)

BEE 588: Current Topics in Ecology and Evolution

Subject matter varies from semester to semester, depending upon the interests of students and staff.
Fall and Spring, 2 credits, S/U grading
May be repeated for credit.

BEE 599: Research

Original investigation undertaken with the supervision of a member of the staff.
Fall and Spring, 1-12 credits, S/U grading
May be repeated for credit.

BEE 670: Informal Seminar

Presentation of preliminary research results and current research problems by students and faculty.
Fall and Spring, 0-2 credits, S/U grading
May be repeated for credit.

BEE 671: Ecology and Evolution Colloquium

A weekly series of research seminars presented by visiting scientists as well as by the faculty. Required every semester of all ecology and evolution graduate students.
Fall, 0-2 credits, S/U grading
May be repeated for credit.

BEE 672: Ecology and Evolution Colloquium

A weekly series of research seminars presented by visiting scientists as well as by the faculty. Required every semester of all ecology and evolution graduate students.
Spring, 0-2 credits, S/U grading
May be repeated for credit.

BEE 679: Seminar on Adaptations of Marine Organisms

Seminars on selected topics concerning ecological, genetical, and evolutionary problems in the marine environment.
Fall or Spring, alternate years, 0-2 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

BEE 690: Seminar on Evolutionary Processes

Seminars on selected topics concerning evolutionary processes.
Fall or Spring, alternate years, 0-2 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

BEE 691: Seminar on Systematics and Phylogeny

Seminars on selected topics in systematics. Topics will include the theory of classification and numerical taxonomy, both phenetic and cladistic.
Fall or Spring, alternate years, 0-2 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

BEE 692: Seminar on the Environment and Human Affairs

Student seminars on selected topics concerned with the effect of man on the environment. Application of ecological and evolutionary theory to the solution of human problems.
Fall or Spring, 0-2 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

BEE 693: Seminar on Population and Community Ecology

Student seminars on selected topics in population and community ecology.
Fall or Spring, 0-2 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

BEE 695: Seminar on Ecological Processes

Seminars on selected topics concerning ecological processes at the individual, population, community, ecosystem, and global levels.
Offered
Fall and Spring, 0-2 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

BEE 699: Dissertation Research on Campus

Prerequisite: Must be advanced to candidacy (G5). Major portion of research must take place on SBU campus, at Cold Spring Harbor, or at the Brookhaven National Lab.
Fall, Spring, and Summer, 1-9 credits, S/U grading
May be repeated for credit.

BEE 700: Dissertation Research off Campus - Domestic

Prerequisite: Must be advanced to candidacy (G5). Major portion of research will take place off-campus, but in the United States and/or U.S. provinces. Please note, Brookhaven National Labs and the Cold Spring Harbor Lab are considered on-campus. All international students must enroll in one of the graduate student insurance plans and should be advised by an International Advisor.
Fall, Spring, 1-9 credits, S/U grading
May be repeated for credit.

BEE 701: Dissertation Research off Campus - International

Prerequisite: Must be advanced to candidacy (G5). Major portion of research will take place outside of the United States and/or U.S. provinces. Domestic students have the option of the health plan and may also enroll in MEDEX. International students who are in their home country are not covered by mandatory health plan and must contact the Insurance Office for the insurance charge to be removed. International students who are not in their home country are charged for the mandatory health insurance. If they are to be...
covered by another insurance plan they must file a waiver be second week of classes. The charge will only be removed if other plan is deemed comparable.

All international students must received clearance from an International Advisor. Fall, Spring, 1-9 credits, S/U grading May be repeated for credit.

**BEE 800: Summer/Winter Research**
May be repeated for credit.

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**BGE Genetics**

**BGE 510: Graduate Genetics**
This course investigates fundamental aspects of the transmission and expression of genetic information in prokaryotic and eukaryotic systems. The course is organized in a way that allows the students to appreciate the breadth of genetics research, while also gaining an in-depth understanding of selected important topics. Students explore the use of both classical and molecular genetic approaches to understand biological processes in genetics model systems including yeast, flies, worms, mouse, and man.

*Spring, 3 credits, Letter graded (A, A-, B+, etc.)*

**BGE 530: Laboratory Rotation**
The student rotates through laboratories of four different genetics program faculty members during the first year. The selection of the laboratories is made by the student, in conjunction with individual faculty, and with the approval of the program director. By taking part in ongoing projects, the student will learn experimental procedures and techniques and become acquainted with research opportunities in the participating programs. Prerequisite: Permission of instructor

*Fall and Spring, 1-8 credits, S/U grading May be repeated 2 times FOR credit.*

**BGE 550: Genetics Outside Seminar**
Outside seminars and special topics courses in areas relating to genetic studies.

*1-6 credits, Letter graded (A, A-, B+, etc.) May be repeated for credit.*

**BGE 599: Graduate Research**
Original investigation undertaken with the supervision of a member of the program.

*Fall and Spring, 1-9 credits, S/U grading May be repeated for credit.*

**BGE 657: Principles of Development**
This course deals with developing systems at all levels from the morphological to the molecular. Illustrative material from both animal and plant kingdoms is used. Special attention is given to gametogenesis, genetic control of early development, transcriptional and translational control of protein synthesis, the role of cell division and cell movements, and cell-to-cell interactions in defining developing systems.

*Prerequisite: MCB 656, matriculation in graduate program or permission of instructor. Fall, 3 credits, Letter graded (A, A-, B+, etc.)*

**BGE 691: Readings in Genetics**
Journal Club on thematic topics in different areas of current genetics research

*Prerequisite: Permission of instructor Fall and Spring, 1 credit, Letter graded (A, A-, B+, etc.) May be repeated for credit.*

**BGE 693: Research Proposal Preparation in Genetics**
A course, based upon literature in the broad field of Genetics, to instruct in scientific writing and the preparation of research proposals. In the first section of the course, students will become familiar with the components of a research proposal and will read and evaluate proposals written by the training faculty. Discussions guided by the course co-directors will cover the basics of scientific writing, research proposal preparation, and the problems and concerns commonly voiced by reviewers of research proposals. In the second section, students will develop and write a research proposal for the student of a topic in genetics that is unrelated to their graduate research. The students' skills in proposal preparation will be enhanced by critiquing the draft proposals presented by other students in the course

*I credit, Letter graded (A, A-, B+, etc.)*

**BGE 699: Dissertation Research on Campus**
Prerequisite: Advancement to candidacy (G5). Major portion of research must take place on SBU campus.

*1-9 credits, S/U grading May be repeated for credit.*

**BGE 700: Dissertation Research off Campus - Domestic**
Prerequisite: Must be advanced to candidacy (G5). Major portion of research will take place off-campus, but in the United States and/or U.S. provinces. All international students must enroll in one of the graduate student insurance plans and should be advised by an International Advisor.

*Fall, Spring, 1-9 credits, S/U grading May be repeated for credit.*

**BGE 701: Dissertation Research off Campus - International**
Prerequisite: Must be advanced to candidacy (G5). Major portion of research will take place outside of the United States and/or U.S. provinces. Domestic students have the option of the health plan and may also enroll in MEDEX. International students who are in their home country are not covered by mandatory health plan and must contact the Insurance Office for the insurance charge to be removed. International students who are not in their home country are charged for the mandatory health insurance. If they are to be covered by another insurance plan they must file a waiver by second week of classes. The charge will only be removed if other plan is deemed comparable.

*All international students must received clearance from an International Advisor. Fall, Spring, 1-9 credits, S/U grading May be repeated for credit.*

**BGE 800: Summer/Winter Research**
May be repeated for credit.

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**BIO**
Biology

BIO 511: Topics in Biotechnology
An introduction to the field of biotechnology. The course will survey the history of the development of genetic engineering, methodologies used in biotechnology, applications of biotechnology in medicine, agriculture and manufacturing, and the implications of these technologies for society. Intended for the students in the MAT Science and MALS programs. This course has an associated fee. Please see www.stonybrook.edu/course fees for more information. Offered
Spring, 3 credits, Letter graded (A, A-, B+, etc.)

BIO 515: Current Topics in Microbiology
A survey of microbiology with an emphasis on microbial ecology, the role of microbes in the biosphere and the methodology used to explore these areas. The course is organized around two resources available online: Unseen Life on Earth: An Introduction to Microbiology, which was produced by The American Society for Microbiology (http://www.learner.org/resources/series121.html) and the New York State core curriculum for The Living Environment (http://www.p12.nysed.gov/ciai/mst/sci/ls.html) . Intended for the students in the MAT Science and MALS programs. This course has an associated fee. Please see www.stonybrook.edu/course fees for more information.
3 credits, Letter graded (A, A-, B+, etc.)

BIO 520: Topics in Genetics
A survey of genetics organized around a particular topic, including gene regulation, developmental genetics, cancer genetics, epigenetics with emphasis on areas with emerging new insight. The methodology used to study these areas will also be explored. Intended for students in the MAT Biology and PhD Science Education programs.
Offered
Fall, 3 credits, Letter graded (A, A-, B+, etc.)

BIO 521: Laboratory Science Curriculum Development
Development of curriculum materials appropriate for a secondary school biology classroom. Students may take this course in their second semester of the Master of Arts in Teaching Science program. Offered
Fall and Spring, 1-6 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

BIO 542: Model Systems for the Living Environment
Introduction to microbial model systems used in biological research such as yeast, nematodes and slime molds. Particular attention will be given to using these systems in the classroom to illustrate key concepts in introductory biology. Students will read and discuss research papers selected from the current scientific literature. Topics to be covered include: life cycle, laboratory techniques and design of inquiry-based investigations.
Offered
Summer, 3 credits, Letter graded (A, A-, B+, etc.)

BIO 558: Biological Basis of Human Evolution and Behavior
A exploration of biological theories of human evolution, properties, and behavior. We build an understanding of evolution of complex organisms by natural selection, followed by the emergence of humans as a uniquely complex species. Scientific hypothesis formation and testing using the extensive multidisciplinary empirical record of the 1.8 million years of human history is developed throughout. Implications of human evolutionary biology for contemporary social and sexual behavior are also investigated.
This course is co-sponsored with BIO 558,
Fall, Spring, 3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

BIO 600: Practicum in Teaching
Fall and Spring, S/U grading
May be repeated for credit.

BIO 601: Practicum in Teaching
Fall and Spring, 1-3 credits, S/U grading
May be repeated for credit.

BME 502: Advanced Numerical & Computation Analysis Applied to Biological Systems
Numerical analyses of Biological Data. A unified mathematical/time series framework for modeling and mining biological data. Applications range from cardio-respiratory, renal blood pressure/flow and sequence (DNA,RNA,proteins) to gene expression data. Tools of data analysis include linear algebra, interpolation and extrapolation, parametric and nonparametric spectral estimation with the FFT and singular value decomposition, statistical description of data and integration of ordinary differential equations. Special focus will be placed on the use of linear and nonlinear numerical methods for the identification of physiological system dynamics and the development of computer simulation techniques to study dynamic response of physiological systems. Cannot be repeated for credit.
Spring, 3 credits, Letter graded (A, A-, B+, etc.)

BME 503: Cell and Molecular Imaging
This course will cover basics of optics, microscopy, spectroscopy and fluorescence in the context of imaging at the cellular and molecular level. Recently developed advanced imaging techniques for probing protein interactions and live cell functions are also discussed. The course is organized in 3 modules:
3 credits, Letter graded (A, A-, B+, etc.)

BME 504: Biomaterials Science and Analysis
Course content is directed toward providing an introductory treatment of the engineering issues implicit in understanding living tissue interactions with processed materials. Emphasis on identifying and eliminating surface contamination, corrosion, and optimizing material surface properties and compatibility.
Spring, 3 credits, Letter graded (A, A-, B+, etc.)

Stony Brook University Graduate Bulletin: www.stonybrook.edu/gradbulletin
BME 505: Principles and Practice of Biomedical Engineering

Introduces first year students to the basic and clinical research at the cutting edge of biomedical engineering. The course has two key components: the first is a seminar series presented by internationally renowned bioengineers. An interactive discussion of topic-specific scientific literature precedes the formal presentation. The second component of the course is teaming up with a physician, in rounds, the operating theater, clinics, etc., to get exposure to the real-life problems which face the medical community. It is hoped that the mix of science and clinic will move students towards determining how they can make contributions to health and society.

1 credit, Letter graded (A, A-, B+, etc.)

BME 508: Molecular and Cellular Biomechanics

Course content revolves around the effects and interactions of mechanical forces at the cellular and molecular level. The topics range from describing the molecular and cellular basis of the adaptation of tissues to physical signals, to prescribing specific mechanical environments for improved tissue engineering, to delineating relevant molecular, cellular, and biomechanical techniques, to issues involved in the development and approval of diagnostics and therapeutics in molecular engineering. Course format is based on lectures and discussion of the current literature. For a deeper understanding of the scientific literature, this course will contain a module on the design and analysis of experiments (i.e., applied biostatistics).

Fall and Spring, 3 credits, Letter graded (A, A-, B+, etc.)

BME 509: Fundamentals of the Bioscience Industry

A 4-module course set up to provide students with a comprehensive introduction to the complexities of the bioscience business environment.

Prerequisite: Must be either a BME or MBA graduate student (West Campus). All other students must obtain permission from the instructor.

Spring, 3 credits, Letter graded (A, A-, B+, etc.)

BME 510: Biomechanics

This course emphasizes the application of continuum mechanics to living tissues and organs in order to describe the material properties and their behavior under loading and stress. The interrelationship between biomechanics and physiology is examined in normal function and in disease processes. This course focuses on the physiology of tissue and organ systems in the context of mechanics, stress, strain, viscoelasticity and material behavior, and the constitutive equations and the field equations governing fluids and fluid flow, with an emphasis on the cardiovascular and musculoskeletal systems. Emphasis is placed on the utilization of engineering principles to analyze processes at the tissue and organ levels, covering soft and hard tissues and organs (blood, cardiovascular system, bone, cartilage, etc.) and to understand how these principles could be applied towards the design and development of prosthetic devices.

3 credits, Letter graded (A, A-, B+, etc.)

BME 511: BioTechnology Enterprises 2: Products & Markets

This course will provide students with a comprehensive introduction to the bioscience business environment by examining the commercialization process, how an idea becomes a product. This includes evaluating business models, product development cycles, regulatory issues, finance, managerial challenges and future trends in the life sciences. Special focus will be placed on preparing students to translate concepts presented in the course into commercial analysis of a technology. Must be either BME or MBA Graduate Student (West Campus)

3 credits, Letter graded (A, A-, B+, etc.)

BME 512: Fundamentals of the Bioscience Industry

This course will build on topics presented in BME-511: Fundamentals of the Bioscience Industry Program, and is a pre- or co-requisite for enrollment. Students will work through modules addressing each component of the commercialization process including intellectual property strategy, market analysis and opportunity, regulatory pathway and technology financing. Students will work in groups to develop commercialization reports based on real intellectual property disclosures, performing due diligence to identify areas of opportunity and challenges of their technologies. Based upon the commercialization report, students' groups will create a hypothetical company, and evolve their technology analyses into investor-like presentations delivered at a mock pitch session at the end of the term.

3 credits, Letter graded (A, A-, B+, etc.)

BME 513: Introduction To Optical & Terahertz Imaging

This course provides the foundations for advanced topics in modern optical imaging techniques, including nonlinear optics, Fourier optics, ultrafast time-domain and terahertz spectroscopy and imaging. The emphasis will be on connecting theory to modern technological advancements and their biomedical applications. The course consists of the following four general modules: Review of fundamental Optics; Nonlinear Optics; Fourier Optics; Ultrafast and Terahertz Optics

3 credits, Letter graded (A, A-, B+, etc.)

BME 515: Biomedical Optical Imaging

An introduction to the principles and applications of biomedical optical imaging, with an emphasis on high-resolution imaging and spectroscopy. This course provides a conceptual overview, along with basic mathematical theory (assignments), of some of the key concepts that are relevant to biomedical optical imaging, including Gaussian beams, refraction, total internal reflection, etc.

3 credits, Letter graded (A, A-, B+, etc.)

BME 517: Radiation Physics

This graduate offering provides an initial physical background required for the study of the Medical Physics. Sources of ionizing radiation including radioactivity (natural and manmade) and x-ray producing devices are studied as well as sources of nonionizing radiation such as radiofrequency and ultrasound. The physical aspects of these radiations are characterized by their interaction with matter and methods for their detection. Each student will select and present a proposal for solving a clinical medical physics problem.

Prerequisites: Modern Physics or equivalent Fall, 3 credits, Letter graded (A, A-, B+, etc.)

BME 518: Radiobiology

The biological consequences of irradiation (ionizing, ultrasound, laser, RF, etc.) will be examined. Interaction mechanisms will first be examined followed by examination of the radiation impact at the molecular and cellular level. The use of radiation for therapeutic gain will be considered. As well, models will be developed for risk estimates. Topics to be covered will include: target theory, biological response, NSD and risk estimates.

Spring, 3 credits, Letter graded (A, A-, B+, etc.)

BME 519: Medical Health Physics

This course discusses the health physics and safety issues associated with radiological devices, facilities and procedures.

Prerequisite: BME 517.

Spring, 3 credits, Letter graded (A, A-, B+, etc.)

BME 520: Lab Rotation I
BME 521: Lab Rotation II

BME 525: Pathways from Bed to Bedside
The course will emphasize diverse pathways from laboratory discoveries to product commercialization in Tissue Engineering and Regenerative Medicine (TERM). Depending on the field of discovery, pathways can be quite dissimilar, e.g. devices, biologics, drugs, or combination products. The foundational sciences include: biomaterials, biological processes including cell biology and physiology, genomics, proteomics, metabolomics, stem cell differentiation, growth factors, and tissue/organ development. An overarching core principle is engineering design. The course will be divided into 3 modules: Discovery and validation, Transition from laboratory prototype to fixed prototype, Progression through clinical trials. Although scale-up manufacturing and commercialization will be discussed, these final steps to the market-place will not be covered in detail. Students will work in teams. Each team will select a TERM project with a specific type of bench to bedside pathway (team size will depend on the class size). However, other BME areas may be included, e.g. microelectron-mechanical systems (MEMS), can be designed to stimulate muscle, thus avoid atrophy while awaiting a TERM construct. For such projects, the team should choose an appropriate BME faculty advisor to guide them. Reading material and writing/speaking assignments will be the basis for in-class discussions with embellishment of specific engineering or scientific principles.
3 credits, May be repeated for credit.

BME 526: Biological Systems Engineering
This course is a hands-on study of systems engineering in biology, using computer modeling to conceptualize and simulate a wide variety of applications. All skills taught in class. Appropriate and applicable to all BME tracks. May not be repeated for credit.
Fall, 3 credits, Letter graded (A, A-, B+, etc.)

BME 530: Medical Image Formation
This course covers the physical aspects of medical image formation. Image receptor design/optimization, reconstruction techniques, device hardware and performance characteristics are considered.
Fall, 3 credits, Letter graded (A, A-, B+, etc.)

BME 531: Biosensing and Bioimaging
Basic concepts of biosensing and bioimaging, which include the elements of biological systems and bioimmobilizers, traditional electrode and novel optical transducers, and advanced biomedical optical imaging systems.
Fall, 3 credits, Letter graded (A, A-, B+, etc.)

BME 532: Time Series Modeling of Biological Systems
A unified mathematical/time series framework for modeling and mining biological data. Applications range from cardio-respiratory, renal blood pressure/flow and sequence (DNA, RNA, proteins) to gene expression data. Tools of analysis include neural networks, time-invariant and time-varying spectral methods, fractal and nonlinear dynamics techniques, hidden Markov Model, clustering analysis, and various system identification techniques.
Spring, 3 credits, Letter graded (A, A-, B+, etc.)

BME 533: Biomedical Imaging Quantification and Analysis
The overall objective is to introduce conceptual, mathematical, and computational implementational aspects of analyzing biomedical signals and image processing, including real data with preclinical and clinical applications based on the recently developing neurophotonics and optical neuroimaging field. Programming examples using MATLAB will be presented. The students will also be introduced to GUI-based Virtual Photonics and Virtual Tissue Simulator. Practical and recent studies with current state-of-the-art imaging technologies in the field are also discussed. The course involves traditional-style lectures, small lab experiments to apply the basic concepts, an imaging facility tour, and a concise final paper/grant writeup and presentation on the subject of the student's choice in accordance with the instructor.
3-4 credits, Letter graded (A, A-, B+, etc.)

BME 534: Functional Genomics
Course provides foundation in concepts of functional genomics and proteomics. Topics include organization and complexity of the mammalian genome and mechanisms of expression of genes, gene expression analysis technologies with a strong focus on construction and utilization of DNA microarrays, and tools for determining gene function by perturbation of gene expression.
Spring, 3 credits, Letter graded (A, A-, B+, etc.)

BME 540: Radiation Oncology Physics
This course provides a background in therapeutic instrumentation, dosimetry and treatment planning.
Prerequisite: BME 517
Fall, 3 credits, Letter graded (A, A-, B+, etc.)

BME 546: Statistical Analysis of Physiological Data
Statistical methods useful in analyzing common types of physiological data. Topics include probability, data distributions, hypothesis testing, with parametric and non-parametric methods, ANOVA, regression and correlation and power analysis. Emphasis is on experimental design and appropriate, efficient use of statistical software.
1 credit, Letter graded (A, A-, B+, etc.)

BME 547: Model-Based Analysis of Physiological Data
The analysis of common biochemical and physiological data by non-linear regression of data models and biophysical models of physiological and biochemical processes. Examples include binding kinetics, compartmental mass transfer and spectral analysis.
1 credit, Letter graded (A, A-, B+, etc.)

BME 548: Measurement and Analysis in Physiological Research
The acquisition and analysis of data-arising from common biochemical and physiological measurements. Topics include computer-based data acquisition and processing, densitometry, microscopy, and image analysis and processing. Emphasis is on experimental design and strategies for optimizing signal to noise ratio of measurements.
1 credit, Letter graded (A, A-, B+, etc.)

BME 549: Experimental Techniques in Systems Physiology
A series of lectures and laboratory exercises designed to introduce students to in vitro experimental techniques used in systems physiology. Emphasis will be placed on the ethical use of rodents in biomedical research and the measurement of physiological variables. Data acquisition and analysis procedures used in cardio-vascular, respiratory, neural and renal physiology will also be covered.
1 credit, Letter graded (A, A-, B+, etc.)

BME 550: Mathematical Models of Physiologic & Biophysical Systems
An introduction to mathematical modeling of cell and tissue function. Topics include the derivation and numerical solution of models of cell homeostasis, membrane transport and
excitability, and cell signaling and metabolism. Grading is based on problems, student presentation, and completion of a modeling project.

3 credits, Letter graded (A, A-, B+, etc.)

BME 558: Physical & Quantitative Biology

This is a course on the principles of physical chemistry. We describe the nature of the forces and energies and entropies that drive molecular systems toward their states of equilibrium. We consider a broad range of applications throughout chemistry, biology, materials engineering and nanoscience. This course aims to give students an understanding of how the actions and behaviors of materials arise from their atomic and molecular structures. Co-listed with PHY 558 and CHE 558.

3 credits, Letter graded (A, A-, B+, etc.)

BME 571: Microfluids in Biological Systems

This course will outline theory and applications of special fluid handling conditions associated with living systems.

Fall, 3 credits, Letter graded (A, A-, B+, etc.)

BME 572: Biomolecular Analysis

This interdisciplinary course is intended for graduate students and advanced undergraduates in departments such as Biomedical Engineering, Chemistry, Physics, Biology and Chemical Engineering. This course will give an introduction to single molecule experiments using fluorescence, optical traps, AFM cantilevers, microneedles, magnetic microbeads as well as micro and nanofluidic devices.

Prerequisites: BME 501 and 502, or instructor approval.

Fall, 3 credits, Letter graded (A, A-, B+, etc.)

BME 573: iPhone Programming for Medical Applications

iPhone Programming for Medical Applications.

3 credits, Letter graded (A, A-, B+, etc.)

BME 574: Machine Learning and Artificial Intelligence for Biomedical Engineering

This course introduces students to machine learning and artificial intelligence methods applied to Biomedical Engineering problems. We will cover singular-value decomposition (SVD), and principal components analysis (PCA), Fourier and Wavelet Transforms, Regression and Model Selection, Clustering and Classification, Deep Learning using Neural Networks, and Scientific Machine Learning. Course emphasis will be placed on the concepts and implementation of machine learning and AI methods as implemented in the Julia programming language. The final project will teach the students how to apply the various methods learned and practiced in the class to tackle real-world complex BME challenges.

3 credits, Letter graded (A, A-, B+, etc.)

BME 581: Biomedical Nanofabrication

This one-semester, three section course, serves as an introduction to the applications of nanofabrication to various fields of importance to biomedical engineering. This will be done by a combination of examining how nature has accomplished nano-scale feats, how we can measure this, and whether we can duplicate nature’s functions in vitro. A significant portion of the course includes technical communications, in the form of a written report and oral lecture component to class.

3 credits, Letter graded (A, A-, B+, etc.)

BME 590: Biomedical Engineering Seminar

A weekly meeting devoted to current graduate student work in the program in Biomedical Engineering. Enrolled students present seminar each week throughout the semester, participate in seminars and responsible conduct of research training.

0-1 credits, S/U grading

May be repeated for credit.

BME 595: BME MS Project

This course is taken M.S. students who select MS Project track. Conducted jointly by graduate students and one or more members of the faculty. A final project report must be submitted to the advisor as well as to the Graduate Program Director. Without the submitted report, credits from this course cannot be applied toward the MS degree.

1-6 credits, Letter graded (A, A-, B+, etc.)

May be repeated 2 times FOR credit.

BME 599: Biomedical Engineering Research

Research to be supported by a faculty member of the Department of Biomedical Engineering. Students must have permission of instructor to enroll in appropriate section. Faculty to be identified by the student.

Fall and Spring, 1-9 credits, S/U grading

May be repeated for credit.

BME 601: Cardiovascular Fluid Mechanics

The course will cover the application of fluid mechanics principles to the analysis of blood flow in the cardiovascular system under normal and pathological conditions. It will follow an historical time line by beginning with the most basic models of arterial blood flow, and proceed to the most advanced theories related to physiology and pathology flow phenomena, including an examination of the most up to date research in the area and the development of devices and implants.

Spring, alternate years, 3 credits, Letter graded (A, A-, B+, etc.)

BME 602: Topics in Biomedical Applications of Neural Networks

This is a project based course which includes weekly seminars discussing advanced topics in fuzzy logic and neural networks and their applications, in biomedical devices. Applications include drug delivery, diagnostics, management information handling. Students utilize simulation software to develop algorithms to deal successfully with training data sets of their own choosing.

Fall, alternate years, 3 credits, Letter graded (A, A-, B+, etc.)

BME 603: Advanced Quantitative Human Physiology

This course is intended to provide a deep and rigorous understanding of human physiology using a quantitative approach. This course will develop the physical, chemical and mathematical foundation of physiology, which is then applied to membranes, transport, metabolisms, excitable cells and various organ systems. A major component of this course will be an individual project requiring mastery of concepts developed in class.

3 credits, Letter graded (A, A-, B+, etc.)

BME 604: Finite Element Modeling in Biology and Medicine

Both finite difference and FEM are applied to solve the equations of incompressible and compressible fluid flow in porous media with emphasis on flows in skeletal tissues, i.e., bone and cartilage. Steady-state, transient flow, permeability and surface boundary conditions are discussed. Practical and recent studies in the field are also discussed. Programming using FORTRAN or C languages will be required. The student is also introduced to commercially available software packages.

Spring, alternate years, 3 credits, Letter graded (A, A-, B+, etc.)

BME 605: Biomechanics of Tactile Sensory Systems

Detailed study of the biomechanics of tactile neurophysiology for engineers entering the field of haptics and robotics manipulations.
Anatomy and electrophysiology of transducer cells and neurons starting at the fingertips and extending to the somatosensory cortex. Characteristics of the external stimulus and its peripheral transformation. Relations of these topics to perceptual and/or behavioral responses.

**Spring, alternate years, 3 credits, Letter graded (A, A-, B+, etc.)**

**BME 608: Contemporary Biotechnology**

General discussion on the nature of biotechnology and its historical development, applications, impact, consequences, and some of the social and ethical considerations.

Co-scheduled with BME 402

Fall, 3 credits, Letter graded (A, A-, B+, etc.)

**BME 610: Magnetic Resonance**

This course provides a comprehensive study of magnetic resonance and its applications in medical imaging. An introduction of NMR is followed with development of the hardware and processing aspects required for MR image formation. An overview of basic and advanced MR imaging techniques is provided. Each student will select a topic in MR imaging for presentation at the conclusion of the course.

Fall, 3 credits, Letter graded (A, A-, B+, etc.)

**BME 611: Positron Emission Tomography**

Positron emission tomography (PET) is a unique and powerful functional imaging method used in the clinic and in medical research. It is a multidisciplinary endeavor involving the fields of chemistry, physics, mathematics and medicine. This course addresses the disparate areas of science underlying PET imaging, including radioisotope production, radiotracer synthesis, the physics of the imaging process, quantitative data processing, image reconstruction approaches, data analysis, and tracer kinetic modeling to extract quantitative physiological parameters. Radioactive validation and applications of PET will also be covered including the area of drug addiction. There is a hands-on component in which students will visit an active PET research center and acquire and manipulate PET data.

3 credits, Letter graded (A, A-, B+, etc.)

**BME 612: Biomedical Engineering Aspects for the Use of Radiation in Medicine**

This course provides a comprehensive study of the use of radiation in medicine. Physical aspects of the interaction of radiation with matter and for the radiation production are initially considered. The underlying principles of current radiation based medical imaging is considered next. Topics include radiography, fluoroscopy, radionuclide imaging and computed tomography. The use of radiation for the treatment of malignancy is considered with the focus on required technology. Finally advanced applications of radiation are considered with focus on imaging and treatment. Each student will select a topic examining the engineering or technical application of radiation in medicine for presentation at the conclusion of the course.

Spring, 3 credits, Letter graded (A, A-, B+, etc.)

**BME 615: Clinical Radiation Oncology**

This course is designed to prepare the Medical Physics graduate student in the area of clinical Radiation Oncology. In this clinical rotation, radiation oncology physics. In this clinical rotation, the students will be exposed to dosimetry, TLD dosimetry, water phantom (radiographic and radiochromic), diode dosimetry, in vitro and in vivo radiation detection systems, imaging systems and their performance evaluations. In addition, basic medical ethics, radiographic anatomy and radiation safety will be covered. A total of 200 clinical hours will be completed in this program

Prerequisites: BME 517 and BME 540 with a B+ or better.

Spring, 4 credits, S/U grading

**BME 617: Clinical Radiation Oncology Physics**

This course is designed to prepare the Medical Physics graduate student in the area of clinical radiation oncology physics. In this clinical rotation, the student will learn by observation and participation some of the following medical physics procedures: LINAC Beam Dosimetry (ion chamber measurement techniques, film dosimetry (radiographic and radiochromic), diode dosimetry, TLD dosimetry, water phantom scanning), implementation of photon and electron beam calibration protocols (AAPM TG51), LINAC beam data measurement and tabulation, commissioning a TPS system, LINAC, acceptance testing, LINAC monthly QA, HDR QA and planning, and IMRT inverse planning and IMRT clinical QA. A total of 120 clinical hours will be completed in this program. Prerequisite: BME 517 and BME 540 with a B+ or better.

Spring, 4 credits, S/U grading

**BME 618: Anatomy for Medical Physics**

This course provides basic radiographic anatomy from both the projection and cross sectional point of view. This course also introduces basic disease processes including the nature and causes of disease and injury. The appearance of these diseases and injuries are examined on medical images acquired through all current methods: radiography, computed tomography, angiography, magnetic resonance, scintigraphy, positron emission tomography and sonography. Details of cancer initiation, growth, staging and treatment are considered. Prerequisite: In Medical Physics Track

4 credits, Letter graded (A, A-, B+, etc.)

**BME 620: Space Radiation Biology**

An extensive series of lectures, training sessions and laboratory activities sponsored by the NASA's Radiation Health Program in collaboration with BNL. The material is oriented to cover basic and state of the art concepts in space radiation environment, physics and radiobiology. Content includes basic concepts in physics, dosimetry, radiobiology, space radiation problems and accelerator operations. Concurrent sessions are provided to complete specific BNL training and plan and prepare experiments for low- and high-LET radiation exposures. Students are trained in NSRL operations and are able to run control experiments using gamma rays in preparation for NSRL runs, and subsequently experiments at the NSRL using heavy ions. Data are obtained from different endpoints are discussed and analyzed with the instructors. Homework are used to test the student's level of comprehension of the lectures and laboratory activities. The write up of a full BNL beam time request proposal is required of each student.

4 credits, Letter graded (A, A-, B+, etc.)

**BME 670: Special Topics in Biomedical Engineering**

Varying topics covering current active research projects and professional development skills for Biomedical Engineers. This course is designed to give the necessary flexibility to...
GRADUATE COURSE DESCRIPTIONS

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students and faculty to introduce and refine new material into the curriculum before it has attracted sufficient interest to be made part of the regular course material. Topics include biomedical engineering, regenerative medicine, bioimaging, biomechanics, career planning, negotiation, communications, long-range planning, among others.

0-3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

BME 690: Biomedical Engineering Research

Biomedical Engineering research for doctoral students who have already received their M.S. degree, but have not yet advanced to candidacy.

Fall and Spring, 1-9 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

BME 698: Practicum in Teaching

Undergraduate teaching to be supervised by a faculty member of the Program in Biomedical Engineering. Course to be identified by the student and graduate studies director.

Fall and Spring, 1 credit, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

BME 699: Dissertation Research on Campus

Prerequisite: Students must be advanced to candidacy (G5); permission of instructor and enroll in appropriate section. A portion of research must take place on SBU campus, at Cold Spring Harbor, or at the Brookhaven National Lab.

Fall, Spring, and Summer, 1-9 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

BME 700: Dissertation Research off Campus - Domestic

Prerequisite: Must be advanced to candidacy (G5). Major portion of research will take place off-campus, but in the United States and/or U.S. provinces. Domestic students have the option of the health plan and may also enroll in MEDEX. International students who are in their home country are not covered by mandatory health plan and must contact the Insurance Office for the insurance charge to be removed. International students who are not in their home country are charged for the mandatory health insurance. If they are to be covered by another insurance plan they must file a waiver be second week of classes. The charge will only be removed if other plan is deemed comparable.

All international students must receive clearance from an International Advisor.

Fall, Spring, 1-9 credits, S/U grading
May be repeated for credit.

BME 800: BME RESEARCH

Full-time summer research.

S/U grading
May be repeated for credit.

BMI

Biomedical Informatics

BMI 501: Introduction to Biomedical Informatics

This course introduces the unique characteristics of clinical and life science data and the methods for representation and transformation of biomedical data, information, and knowledge to improve human health. The course will provide an overview of basic concepts and will serve as a Launchpad into other more focused courses that explore the computational and analytics needs of BMI, as well as the clinical, research and translational applications of informatics. There will be three major themes: Information representation, management and sharing; biomedical data representation and management; standards, terminologies, and ontologies such as HL7, IHE, SNOMED, ICD-9; Privacy, confidentiality and data sharing. Clinical Informatics: Health care environment and processes; electronic health records and management; clinical decision making clinical information retrieval clinical natural language processing. Imaging informatics: radiological image modalities; DICOM and PACS systems; computer-aided diagnosis; digital pathology; analytical pathology imaging. This course will provide hand-on assignments for the participants to familiarize the concepts. Prerequisite: Graduate standing in BMI or permission of instructor.

3 credits, Letter graded (A, A-, B+, etc.)

BMI 502: Life Sciences for Biomedical Informatics

This course presents the fundamentals of computer science and problem solving for computer programming. Students learn how computers store and manipulate data using programming languages and algorithms and how computers are controlled by operating systems and networked. Software engineering, data abstractions, and database management systems are described. Applications include computer graphics and artificial intelligence. A theory of computing is presented. Approaches to devising solutions to problem are discussed. Structured programming tools are presented including sequential and decision logic and loops. Data and file operations are explained including processing arrays, sorting, stacks, queues, linked lists, and binary trees. Object-oriented programming and sequential file applications are discussed. Can be used for credit toward masters or doctoral degree in BMI only with permission and NOT in addition to BMI 503. Can NOT be used for credit toward certificate in Biomedical Informatics.

3 credits, Letter graded (A, A-, B+, etc.)

BMI 503: Computer Science for Biomedical Informatics

This course presents the fundamentals of computer science and problem solving for computer programming. Students learn how computers store and manipulate data using programming languages and algorithms and how computers are controlled by operating systems and networked. Software engineering, data abstractions, and database management systems are described. Applications include computer graphics and artificial intelligence. A theory of computing is presented. Approaches to devising solutions to problem are discussed. Structured programming tools are presented including sequential and decision logic and loops. Data and file operations are explained including processing arrays, sorting, stacks, queues, linked lists, and binary trees. Object-oriented programming and sequential file applications are discussed. Can be used for credit toward masters or doctoral degree in BMI only with permission and NOT in addition to BMI 502. Can NOT be used for credit toward certificate in Biomedical Informatics.

3 credits, Letter graded (A, A-, B+, etc.)

BMI 511: Translational Bioinformatics

This course will provide students with an integrative computational toolbox at the intersection between Biomedical and Quantitative Sciences. Students will develop storage, analytic, and interpretive methods to optimize the transformation of large biomedical and genomic datasets, into proactive, predictive, preventive, and participatory health information. Applying a working knowledge of Computational Statistics in a Biomedical/Biomolecular context, students will gain the ability to integrate those Computational Tools and Big Data resources in the Biomedical research enterprise as well as in the clinical workflow.
Accordingly, this course will familiarize the participants with the data processing methodologies associated with a range of biological signals that spans from Biological sequences to Histology images, and from mining medical records to Genome Wide Association Studies (GWAS) and gene prioritization.

**3 credits, Letter graded (A, A-, B+, etc.)**

**BMI 512: Clinical Informatics**

This course offers a comprehensive study of Clinical Informatics. It provides a holistic review of the health care delivery system both historically and presently. It presents Clinical Informatics and its legal and ethical issues, followed by an overview of Clinical Informatics. This includes data content and structures; nomenclatures and classification systems; quality, performance, utilization, and risk management; Clinical Informatics databases; and a review of statistics and research. Clinical informatics management principles and theories presented include change, project, and knowledge management. Aspects of human resources and financial management, including reimbursement methodologies are presented as these relate to Clinical Informatics.

**3 credits, Letter graded (A, A-, B+, etc.)**

**BMI 513: Imaging Informatics**

Imaging Informatics is a multidisciplinary field which intersects Clinical Informatics, medical physics, engineering, computer and information sciences. It touches concepts across the whole imaging chain, including image creation and acquisition, image distribution and management, image storage and retrieval, image processing, analysis and understanding, image visualization and interpretation. The goals of the course are to gain familiarity with the terminology, core concepts, and standard practices, understand the current state of the field and enable critical reading of the literature and to perform research. The course will cover both radiological imaging and pathology imaging. Topics include: radiological imaging modalities, DICOM standards, image management and PACS systems, image exchange and HIE, image processing techniques, content based image retrieval, structured reporting and annotations, image visualization, digital pathology and analytical pathology imaging. The course will also cover emerging technologies in Imaging Informatics. The course will also cover biomedical imaging informatics. Topics include image visualization, enhancement, processing and analysis, with focus on the applications in medical fields. It covers a broad spectrum of biomedical image analysis techniques: image enhancement, segmentation, registration, texture analysis, morphometry, and tractography. Their applications in diagnostic and therapeutic imaging will be extensively discussed. The course will also cover a wide range of image modalities: Magnetic resonance imaging (with its various subtypes). Computed tomography, Ultrasound, Positron emission tomography, Single-photon emission computed tomography, etc., with an emphasis on the interplay and fusion of multi-source information. The computation/analysis will be carried out using languages such as Matlab, C++, Python, Java, etc., based on well tested open sources algorithm packages such as the Insight Toolkit. Moreover, softwares more geared towards end-users, such as 3D Slicer, ImageJ, FreeSurfer, etc. will also be introduced.

**3 credits, Letter graded (A, A-, B+, etc.)**

**BMI 517: Current Research in Signaling Pathways, Biochemistry, and Tissue Morphology of Disease**

In this seminar course, students will explore current knowledge and lines of research inquiry for a disease of their choice, with respect to Signaling Pathways, Biochemistry, and Tissue Morphology. Students will learn to analyze and synthesize research literature for a particular disease topic and propose a testable hypothesis for a research project that would advance one or more lines of research inquiry for the disease. Students will provide feedback for other students' literature reviews.

**3 credits, Letter graded (A, A-, B+, etc.)**

**BMI 520: Data Analytics and Software Stacks**

This course will cover cutting-edge data analytic applications, infrastructure, and analytic methods. Students will have the opportunity to analyze real (de-identified) healthcare datasets and spatio-temporal and molecular datasets drawn from cancer research. Each class session will include discussions of applications, infrastructure, and algorithms. Students will present papers, and there will also be guest lectures from visiting experts. Students will attend lectures, present and critique papers, and work with a team of students on a substantial project throughout the semester. Students are expected to demonstrate a high level of independence, critical thinking, and initiative.

**3 credits, Letter graded (A, A-, B+, etc.)**

**BMI 530: Software Development in Biomedical Informatics**

This is an advanced topic in the BMI series, designed for participants with plans to develop Biomedical Informatics software applications. The BMI530 course is divided in two parts. The first part will provide an overview of approaches to software development in a Biomedical context, where reproducibility, governance and availability are particular concerns. The participants will be introduced, hands-on, to practices such as the use of version control services (such as GitHub), collaborative development models (such as agile programming, extreme programming, unit testing, continuous code review, pair programming etc) and software architectural patterns (such as Model-View-Controller, MVC, and Model-View-Adapter, MVA). The increasing reliance on Cloud Computing infrastructure and Web 3.0 technologies for both software development and deployment will be object of particular attention. The increasing reliance on Big Data resources in Biomedicine, and the broadening use of Web Computing will be approached as part of the exercise of configuring class projects for the second part of the course. Accordingly, a particular focus will be put on the use of Represention State Transfer (REST) architectures and hands-on familiarization with REST APIs (Application Programming Interfaces). The second part of the course will put these concepts into practice through the development of small software projects. Groups of one to three people per project development team will be configured to develop software that solves problems brought to the class by the participants, preferably, but not necessarily, as contributions to manuscripts and/or funded research. Prerequisite: BMI 503 and programming experience, BMI 520, or permission by instructor (face-to-face meeting required).

**3 credits, Letter graded (A, A-, B+, etc.)**

**BMI 531: Advanced Computer Science for Biomedical Informatics**

Data management is a key area of competency in biomedical informatics. This course will cover the concept of database design, data modeling, data management and analytical queries. Topics include relational models, conceptual modeling, relational database implementation, SQL queries, spatial database and GIS, XML databases, NoSQL databases, and big data platforms such as Apache Hadoop and Spark. It will also cover data management for electronic health records, and GIS for public health.
3 credits, 
May be repeated for credit.

BMI 540: Statistical Methods in Biomedical Informatics
Recent advances in high-throughput experimental technologies generate enormous amounts of data. In order to extract insights from such large-scale data sets, robust statistical models and efficient computation methods are indispensable. This course introduces probability and statistical modeling and analytical methods commonly used in biomedical-informatics. Basic probability theory will be briefly reviewed and the course will focus on the construction and solving of statistical modeling based on real biomedical data sets. The methods covered include maximum likelihood estimation, Bayesian inference, dynamic programming, Markov Models, Monte Carlo simulation, classification and clustering. Students will learn to use statistical programs and related resources locally and on the Internet, with an emphasis on the computational aspects of the statistical models in order to harness the ever-growing hardware power. Upon finishing the course, the students will master advanced applications of statistical computing in a wide range of biological and biomedical problems. PREREQUISITES: BMI 501; Basic knowledge in probability theory, algorithms and programming experience in R/MATLAB/ C/C++ are expected. Knowledge in biology is a plus but not a must. 
3 credits, Letter graded (A, A-, B+, etc.)

BMI 541: Advanced Statistical Methods Informatics
This course will introduce students to advance statistical methods in informatics. Students will be introduced to basics of optimization, control, information geometric techniques how such methods can be applied towards problems of imaging, networks and learning. This class will be a continuation of BMI 540 and basic statistical methods and probability concepts will be reintroduced. Students learn basic ability to derive new models that can be applied to generalized informatics. Upon finishing this course, student will have master advanced application of how to utilize standard statistical knowledge coupled with ability to implement such algorithms. 
3 credits, 
May be repeated for credit.

BMI 550: Clinical Informatics Practice Patterns
This course provides detailed information on Clinical Informatics in a variety of practice settings including hospitals, freestanding ambulatory care, managed care, dialysis, correctional facilities, long-term and acute mental health, substance abuse, developmental disabilities, long-term care, rehabilitation, home health, hospice, dental, veterinary, and consulting. The role of Clinical Informatics in each setting is described with respect to regulatory issues; documentation; reimbursement and funding; information management, including data flow, coding and classification, computer systems, and data set; quality improvement, utilization and risk management, and legal issues; the role of the Clinical Informatics professional, and changes and trends.
3 credits, Letter graded (A, A-, B+, etc.)

BMI 551: Case Studies in Clinical Informatics
This course presents cases based on real-life challenges in Clinical Informatics. Critical thinking is essential for the Clinical Informatics professional and case studies demand that students develop thought and action plans and then, in class, present and defend their choices. Each case exposes the student to a complex Clinical Informatics scenario, requiring the student to synthesize information and strategically solve problems using Clinical Informatics principals. Learning through the case method helps students to \textquotedblleft bridge the gap\textquotedblright, from content knowledge for previous and/or current courses to on-the-job Clinical Informatics experience. 
3 credits, Letter graded (A, A-, B+, etc.)

BMI 552: Quality Improvement Methods for Clinical Informatics
Teaches health care management professionals how to perform improvement projects and incorporate quantitative measurement into daily work routines to form the foundation for a quality improvement-oriented culture. Using Minitab software, provides strategies to gather and analyze the data needed to plan, implement, monitor, and evaluate health care quality improvement initiatives. 
3 credits, Letter graded (A, A-, B+, etc.)

BMI 560: Personalized Medicine
This course is focused on the multidisciplinary research and clinical context associated with the development of personalized health care delivery solutions. It will place particular emphasis on assessing opportunities identified by translational and operational research of the clinical settings that define the practical utility of personalized medicine. Accordingly, the clinical decision support systems (CDS)[JA1] being developed for clinical pharmacogenomics, specifically those that establish pharmacotyping in drug prescription, will play a central role in this course. Its content will cover innovative drug formulations and nanotherapeutics, molecular imaging and signatures, medical genomics[JA2], translational nanomedicine and informatics, stem cell therapy approaches, modeling and predictability of drug response, pharmacogenetics-guided drug prescription, pediatric drug dosing, pharmacovigilance and regulatory aspects, ethical and cost-effectiveness issues, pharmacogenomics knowledge bases, personal genome sequencing, molecular diagnostics, as well as information-based medicine. 
3 credits, Letter graded (A, A-, B+, etc.)
Following the article presentation, the thoughts that the article provoked will be discussed together.

3 credits, Letter graded (A, A-, B+, etc.)
May be repeated 1 times FOR credit.

BMI 596: Special Problems in Biomedical Informatics
Examination of special problems in Biomedical Informatics, conducted jointly by graduate students and one or more members of the faculty.

1-6 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

BMI 598: M.S. Capstone Project in Biomedical Informatics
M.S. Independent Capstone project planning and project execution under the supervision of a Biomedical Informatics faculty member. Only open to M.S. students in Biomedical Informatics who will do a Capstone project. Credits earned from BMI 599 may not be used to fulfill requirements for students in Biomedical Informatics who will write an M.S. thesis and not do a Capstone project.

1-6 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

BMI 599: M.S. Research and Thesis in Biomedical Informatics
M.S. Research and Thesis project under the supervision of a Biomedical Informatics faculty member. Only open to M.S. students in Biomedical Informatics who will write an M.S. thesis. Credits earned from BMI 599 may not be used to fulfill requirements for students in Biomedical Informatics who will do a Capstone project and not write an M.S. thesis.

1-12 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

BMI 620: Advanced Topics in Clinical Informatics
The subject matter of each special topics course varies from semester to semester, depending on the interests of students and faculty. Advanced topics and specialized topics will be discussed, particularly those of current interest.

3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

BMI 625: Advanced Topics in Imaging Informatics
The subject matter of each special topics course varies from semester to semester, depending on the interests of students and faculty. Advanced topics and specialized topics will be discussed, particularly those of current interest.

3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

BMI 690: Independent Study in Biomedical Informatics
Independent study in Biomedical Informatics. Must have the approval of the Research and Directed Study Committee of the Department of Biomedical Informatics prior to registration.

1-3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

BMI 691: Independent Reading in Biomedical Informatics
Supplementary specialized readings in Biomedical Informatics for graduate students under faculty supervision. Must have the approval of the Research and Directed Study Committee of the Department of Biomedical Informatics prior to registration.

1-3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

BMI 692: Biomedical Informatics Candidates Seminar
This course is designed to expose students to current research and other topics in Biomedical Informatics. Speakers are invited from both on and off campus.

1 credit, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

BMI 695: Special Topics in Biomedical Informatics
Examination of special topics in Biomedical Informatics, by one or more members of the faculty.

1-3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

BMI 696: Special Problems in BMI
Examination of special problems in Biomedical Informatics, conducted jointly by graduate students and one or more members of the faculty.

1-6 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

BMI 697: Practicum in Teaching I
An introduction to teaching Biomedical Informatics, including course design, learning theory, evaluation of teaching, and teaching with technology.

3 credits, Letter graded (A, A-, B+, etc.)
May be repeated 1 times FOR credit.

BMI 698: Practicum in Teaching II
Graduate students assist the faculty in teaching by conducting recitation or laboratory sections that supplement a lecture course.

3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

BMI 699: Dissertation Research-On Campus
Independent research conducted on campus under the supervision of a Biomedical Informatics faculty member in support of the Ph.D. Dissertation. Permission to register requires the agreement of the faculty member to supervise the research. May be repeated

1-12 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

BMI 700: Dissertation Research-Off Campus, Domestic
Independent research conducted off campus, in the United States, under the supervision of a Biomedical Informatics faculty member in support of the Ph.D. Dissertation. Permission to register requires the agreement of the faculty member to supervise the research. May be repeated

1-2 credits, Letter graded (A, A-, B+, etc.)
May be repeated 1 times FOR credit.

BMI 701: Dissertation Research-Off Campus, International
Independent research conducted off campus, outside the United States, under the supervision of a Biomedical Informatics faculty member in support of the Ph.D. Dissertation. Permission to register requires the agreement of the faculty member to supervise the research.

1-12 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

BMI 800: Full-Time Summer Research
Independent research conducted off campus, in the United States, under the supervision of a Biomedical Informatics faculty member in support of the Ph.D. Dissertation. Permission to register requires the agreement of the faculty member to supervise the research. May be repeated.

0-12 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.
Neurobiology and Behavior

BNB 551: Writing Neuroscience
Seminar course for doctoral students in Neuroscience providing practical instruction in written communication in Neuroscience. Topics include writing effective abstracts, cover letters, figure captions, and grant specific aims, among others.
1 credit, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

BNB 552: Neurobiological Techniques
A series of laboratory exercises designed to give students hands-on experience in the basic laboratory techniques of contemporary neuroscience. Includes intracellular and extracellular recording, neuronal tissue culture, neuroanatomical techniques, and integrative physiology.
Fall, 2 credits, Letter graded (A, A-, B+, etc.)
May be repeated 2 times FOR credit.

BNB 555: Laboratory Rotations in Neuroscience
Course for doctoral students in Neuroscience in which students participate in three formal laboratory rotations in program faculty laboratories during the first year. Students make oral presentations for each rotation. Instruction is provided in how to organize and present material in a seminar format, including the proper use of visual aids. Enrollment restricted to students in the Graduate Program in Neuroscience.
Fall and Spring, 0-5 credits, Letter graded (A, A-, B+, etc.)
May be repeated 2 times FOR credit.

BNB 556: Introduction to Mammalian Neuroanatomy
This course consists of visual presentations and supplemental lectures providing an overview of the structural organization of the nervous system. The mammalian nervous system and its sensory, motor and cognitive components are emphasized. Opportunities for examination of whole brains and historical sections, and some hands-on experience with basic neuroanatomical techniques may also be available.
1 credit, Letter graded (A, A-, B+, etc.)

BNB 561: Introduction to Neuroscience
First of a two semester core course introducing students to basic principles of neuroscience. The major focus is cellular and molecular neuroscience. Topics covered include the ionic basis of resting potentials and electrical excitability, the structure, function and molecular biology of voltage- and ligand-gated ion channels, exocytosis, cellular networks, and gene regulation.
4 credits, Letter graded (A, A-, B+, etc.)

BNB 562: Introduction to Neuroscience II
Second of two-semester core course introducing students to basic principles of neuroscience. The major focus is systems neuroscience. Topics covered include analyses of all major sensory systems, motor systems, and systems mediating higher order, cognitive functions in the nervous system.
4 credits, Letter graded (A, A-, B+, etc.)

BNB 563: Advanced Topics in Neuroscience: Individual Learning Plans
In this 12 hour module course, students will work with an identified faculty preceptor on an agreed upon topic of interest. Agreement of preceptor and an outline of the topic must be submitted to and approved by the Course Director in order for students to register for this class. Students and preceptors will work together to develop a reading list (minimum 6-10 papers) from the primary literature that adequately covers the topic. Students will present two or more of these papers in journal club format to the preceptor and to a larger group, e.g., a lab group, as applicable. Students will also synthesize their readings into a written report that follows one of the following Nature Reviews Neuroscience formats (below, but strict adherence to word limits, reference numbers, etc., is NOT expected). NOTE: Students and their research faculty mentors are strongly encouraged to consider using this as a vehicle for delving deeply into a topic or technique of interest that is relevant to the thesis/thesis proposal. Offered:
Fall, 1 credit, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

BNB 564: Advanced Topics in Neuroscience: Curriculum Development
In this 12 hour module course, students will work with an identified faculty preceptor on an agreed upon topic of interest that addresses a gap in the current Graduate Program in Neuroscience curriculum. Agreement of preceptor and an outline of the topic selected must be submitted to and approved by the Course Director in order for students to register for this class. Students and preceptors will work together to develop a course based on the selected topic. Students will first investigate principles of curricular design. They will follow these in generating a course description, a list of overall learning objectives, and a detailed syllabus that identifies the titles, learning objectives and required background readings for each of the course’s sessions. Required readings much include both texts and the primary literature. Students will also generate the in-class materials for at least two class sessions. One must be a Powerpoint for a standard lecture, and one must be any materials needed for some form of active learning (individual or group) of the material. Finally, students must identify the means that students will be evaluated, and identify how these methods will demonstrate achievement of the stated learning objectives, keeping in mind that the form of evaluation will differ depending on whether objectives are related to knowledge, skills, etc. NOTE: Students and their research faculty mentors are strongly encouraged to consider using this as a vehicle for delving deeply into a topic or technique of interest that is relevant to the thesis/thesis proposal. Offered:
Spring, 1 credit, Letter graded (A, A-, B+, etc.)
May be repeated 1 times FOR credit.

BNB 565: Advanced Neurosciences
A modular course introducing concepts in the development of the nervous system. Topics can include neuroembryology, neuronal differentiation, synapse formation, and specificity and plasticity of connections in vertebrates and invertebrates.
Offered
Fall, 1 credit, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

BNB 566: Neurobiology of Disease
This advanced seminar course is coordinated with the Neurobiology of Disease lecture series hosted by the Program in Neuroscience each Spring semester. The Program invites 5-6 distinguished scientists to present research seminars organized around the broad topic of neurobiological and neurological diseases. Students read and discuss papers recommended by the guest speakers. This course also provides students the opportunity to meet with the guest seminar speakers.
Offered
Spring, 1 credit, Letter graded (A, A-, B+, etc.)
May be repeated 1 times FOR credit.

BNB 567: Statistics and Data Analysis in Neuroscience I: Foundations
This course will introduce students to the fundamental principles and methods of the statistical analysis of neural and behavioral data. A major focus of the course will be on how to properly design experiments to test hypotheses, how to avoid common misconceptions and errors in data analysis and how to report statistics correctly in manuscripts submitted for publication.
This course will aim at providing a rigorous foundation of general statistical principles that can be applied generally, with an emphasis on material of high relevance to biology and neuroscience. A companion course (statistics and data analysis for neuroscience II: Applications) will turn to selected applications to neuroscience. The students will also have the opportunity to hone their statistics skills by analyzing different types of datasets (genetic, molecular, cellular, synaptic, imaging, spike and behavioral) in the MATLAB (or similar) computing environment.

2 credits, Letter graded (A, A-, B+, etc.)

BNB 568: Statistics and Data Analysis in Neuroscience II: Applications

BNB 597: Seminar Themes

This course focuses on current research topics in neuroscience and is integrated with the Neuroscience Seminar Series. It is centered on a common research theme. Students discuss manuscripts, attend seminars and meet with outside speakers.

Offered Fall/Spring, 1 credit, Letter graded (A, A-, B+, etc.)
May be repeated 2 times FOR credit.

BNB 599: Research

Original investigation undertaken with supervision of a member of the staff.

Fall and Spring, 1-12 credits, S/U grading
May be repeated for credit.

BNB 655: Neuropharmacology

An advanced course for graduate students interested in developing an understanding of neurotransmission as receptors, receptor signaling pathways, and G-protein-coupled receptors are developed. Recent advances in cell and molecular biology provide the framework for instruction and discussion. This course is offered as both BSH 655 and BNB 655.

Prerequisite: Admission to Graduate Health Sciences Center Program.

Spring, 3 credits, Letter graded (A, A-, B+, etc.)

BNB 697: Neuroscience Seminar Series

Seminar presentations delivered by faculty, associates, students and visiting speakers.

Fall and Spring, 0-2 credits, S/U grading
May be repeated for credit.

BNB 699: Dissertation Research on Campus

Original investigations undertaken as part of the Ph.D. program under the supervision of the dissertation committee. Prerequisite: Must be advanced to candidacy (G5). Major portion of research will take place on SBU campus, at Cold Spring Harbor, or at the Brookhaven National Lab.

Fall, Spring, and Summer, 1-9 credits, S/U grading
May be repeated for credit.

BNB 700: Dissertation Research off Campus - Domestic

Prerequisite: Must be advanced to candidacy (G5). Major portion of research will take place off-campus, but in the United States and/or U.S. provinces. Please note, Brookhaven National Labs and the Cold Spring Harbor Lab are considered on-campus. All international students must enroll in one of the graduate student insurance plans and should be advised by an International Advisor.

Fall, Spring, 1-9 credits, S/U grading
May be repeated for credit.

BNB 701: Dissertation Research off Campus - International

Prerequisite: Must be advanced to candidacy (G5). Major portion of research will take place outside of the United States and/or U.S. provinces. Domestic students have the option of the health plan and may also enroll in MEDEX. International students who are in their home country are not covered by mandatory health plan and must contact the Insurance Office for the insurance charge to be removed. International students who are not in their home country are charged for the mandatory health insurance. If they are to be covered by another insurance plan they must file a waiver be second week of classes. The charge will only be removed if other plan is deemed comparable.

All international students must received clearance from an International Advisor.

Fall, Spring, 1-9 credits, S/U grading
May be repeated for credit.

BNB 800: SUMMER RESEARCH

May be repeated for credit.

BSB 510: Experimental Biochemistry and Structural Biology

An introduction to modern biochemical research techniques. The student spends a half-semester in the laboratory of each of four different members of the faculty. In each laboratory, the student participates in some aspect of the research being pursued by the faculty member. Prerequisite: Must be matriculated in BSB Graduate Program or permission of instructor.

Fall 1-6 credits, Letter graded (A, A-, B+, etc.)

BSB 512: Structural Biology and Spectroscopy

Theoretical principles and experimental methods used in the study of proteins and nucleic acids, e.g., spectroscopy, magnetic resonance and diffraction.

Prerequisites: MCB 520, or undergraduate physical chemistry course, plus matriculation in graduate program or permission of instructor.

Fall, 2 credits, Letter graded (A, A-, B+, etc.)

BSB 515: Computational Methods in Biochemistry and Structural Biology

Computational methods used in sequence searching and analysis, bioinformatics, graphical analysis of proteins, and nucleic acids. Prerequisite: This class is restricted to first year BSB, HBM, MCB PHD, & HBH PhD students. Exception requires approval from the course instructor.

Fall, 1 credit, S/U grading

BSB 532: Journal Club in Biochemistry and Structural Biology

Provides students with a forum for acquiring skills involved in the critical analysis and presentation of scientific data by active participation in seminars of major topics in structural biology and biochemistry, and critical discussion of selected topics with presentation of papers from the literature. Prerequisite: Must be matriculated in BSB Graduate Program or permission of instructor.

1 credit, Letter graded (A, A-, B+, etc.)
May be repeated for credit.
BSB 580: Advanced Structural Biology/Structural Methods in Drug Discovery
This course is designed for students who want to gain theoretical and practical experience in macromolecular structure determination through NMR spectroscopy and/or X-ray crystallography. The course is organized into two modules: NMR spectroscopy and X-ray crystallography. Students may elect to take one or both modules. Emphasis will be placed on practical aspects of structural determination, including sample preparation, data collection and processing. In each of the modules, students will be guided through a complete structural determination project. A final project report per module will be required. Familiarity with Linux is desirable. Students are encouraged to contact instructors prior to enrolling. Crosslisted as BSB580 and HBH585.

BSB 581: Teaching Honors
Selected students whose performance in the basic required courses for the graduate program is in the top 10 percent conduct tutorials for first-year graduate students in the program and other students taking graduate courses for credit. The tutors are supervised and graded by faculty of the graduate program. Successful completion of this course makes students eligible to receive "Honors in Teaching" on their transcripts.

BSB 599: Research
Original investigation undertaken with the supervision of a faculty member.
Prerequisite: Must be matriculated in BSB Graduate Program or permission of instructor. Fall and Spring, 1-12 credits, S/U grading. May be repeated for credit.

BSB 601: Colloquium in Biochemistry and Structural Biology
A weekly series of talks and discussions by visiting scientists covering current research and thinking in various aspects of structural biology and biochemistry.
Prerequisite: Must be matriculated in BSB Graduate Program or permission of instructor. Fall, 0-1 credits, S/U grading. May be repeated for credit.

BSB 604: Student Seminars in Biochemistry and Structural Biology
Seminars given by graduate students on the progress of their own thesis research. Required of all students every semester in which they are registered in the Graduate Program in Biochemistry and Structural Biology. Attendance is mandatory. Visitors are welcome.
Prerequisite: Must be matriculated in BSB Graduate Program or permission of instructor. Fall and Spring, 1 credit, S/U grading. May be repeated for credit.

BSB 609: Dissertation Research on Campus
Original investigations undertaken as part of the Ph.D. program under supervision of a research committee.
Prerequisite: Advancement to candidacy (G5). Major portion of research must take place on SBU campus, or at the Brookhaven National Laboratory. Fall, Spring, and Summer, 1-9 credits, S/U grading. May be repeated for credit.

BSB 700: Dissertation Research off Campus - Domestic
Prerequisite: Must be advanced to candidacy (G5). Major portion of research will take place outside of the United States and/or U.S. provinces. Please note, Brookhaven National Labs and the Cold Spring Harbor Lab are considered on-campus. All international students must enroll in one of the graduate student insurance plans and should be advised by an International Advisor.
Prerequisite: Must be matriculated in BSB Graduate Program or permission of instructor. Fall, Spring, 0-9 credits, S/U grading. May be repeated for credit.

BUS 510: Biotechnology Startups and Operations
A startup is not a smaller version of a large biotech company. Instead, it is a team testing a business plan for viability. In this course, students will learn about the operational side of a biotech startup, with particular focus on the first steps an entrepreneur must take through to the initiation of a Phase I clinical trial. The goal of this course is not to gain expertise in all areas; rather students will be familiar with all of the varied topics a startup must consider and be better prepared to work holistically within a startup environment. Future CEOs will have a better understanding of the myriad topics they must form a team to address, patent attorneys will understand regulatory needs, and clinical trial coordinators will recognize the needs of the marketing department. For additional information on evaluating technologies and marketing strategies, students are encouraged to take BME-511 and BME-512 as part of the Bio-Based Entrepreneurship Advanced Graduate Certificate (BBe-AGC). Prerequisite: BME 511
3 credits, Letter graded (A, A-, B+, etc.)
BUS 520: Law and Foreign Policy in International Business
Law and Foreign Policy in International Business is designed to provide MBA candidates with an appreciation for the legal regimes and foreign policy issues affecting international business in the 21st Century. The course is designed for non-lawyers, and does not require any previous legal training or familiarity with legal concepts. For each topic, students will consider not only descriptive and practical considerations, such as the substance of a law, the mechanics of the relevant institutions, enforcement regimes, etc., but also normative and ethical questions. The course will rely heavily on current affairs and case studies drawn from the headlines. Although the course will focus predominantly on international regimes and U.S. laws and policies, we will, when appropriate, compare U.S. legal regimes and policies to those in other countries.
3 credits, Letter graded (A, A-, B+, etc.)

BUS 545: Ethics and Health Care
This course provides students with a framework for identifying ethical dilemmas in professional health care settings and the skills and resources for addressing them. The course introduces students to the importance of respecting patients' rights, maintaining confidentiality and honoring professional codes of ethics and provides students with an ethical foundation for working as a professional in a health care environment. Prerequisite: Enrolled in Healthcare Management
3 credits, Letter graded (A, A-, B+, etc.)

BUS 554: The Lean Launch Pad: Turning a great idea into a great company
This course provides real world, hands-on learning of what it’s like to actually start a high-tech company. This class is not about how to write a business plan, and the end result is not a PowerPoint presentation to venture capitalists. Instead, students will get their hands dirty talking to customers, partners and competitors as they encounter the chaos and uncertainty of how a startup actually works. Students work in teams learning how to turn a great idea into a great company. They will learn how to use a business model to brainstorm each part of a company and customer development to get out of the classroom to see whether anyone other than themselves would want/use their product. Finally, they will see how agile development can help them rapidly iterate their product to build something customers will use and buy. Offered in Fall and Spring.
3 credits, Letter graded (A, A-, B+, etc.)

BUS 567: Intellectual Property Strategy
Concepts and techniques of strategic management are examined and applied to relevant cases involving the management of intellectual property as applied to a wide range of industries and innovations. From targeted genomic medications based on new nanotechnologies to the Harry Potter series, the monetization of the creative output of scientists, artists, designers, writers, publishers, product designers, directors and so on all involve the use of one or more forms of intellectual property. The course will begin with a brief overview/review of some principals of management strategy. There will then be a survey of the types of intellectual property, and some of the laws that support exclusivity in intellectual property rights. Students will explore the use and importance of intellectual property rights by companies and individual innovators in building and sustaining a competitive advantage, as well as strategies used to realize the highest value from intellectual property. Prerequisite: MBA 501
3 credits, Letter graded (A, A-, B+, etc.)

CHE 502: Mechanisms and Strategies in Organic Synthesis
This course will focus on (1) the meaning and practice of writing organic reaction mechanisms and (2) standard synthetic reactions, their mechanisms, and modern refinements. Examples and applications will be presented. The course will also discuss biomimetic syntheses and the use of mechanism in designing total syntheses.
Fall, 3 credits, Letter graded (A, A-, B+, etc.)

CHE 503: Synthetic Organic Chemistry
A survey of the most important organic reactions from the viewpoint of synthetic utility, including many recent innovations in this field. Throughout the discussion of these methods, emphasis is placed upon their use in the synthesis of complex organic structures.
Spring, 3 credits, Letter graded (A, A-, B+, etc.)

CHE 504: Structure and Reactivity in Organic Chemistry
Electronic and stereochemical theories relating to organic structure and reactions. Topics such as bonding, strain, aromaticity, MO theory, molecular rearrangements, pericyclic reactions, and photochemistry are covered. This course is intended to provide a foundation of knowledge at the beginning graduate level as preparation for advanced subjects in CHE 502 and CHE 503, and is complementary to CHE 501.
Fall, 3 credits, Letter graded (A, A-, B+, etc.)

CHE 511: Structural Inorganic Chemistry
Properties and reactions of inorganic compounds are considered from the viewpoint of molecular and electronic structure. The modern bonding theories used in inorganic chemistry including molecular orbital, valence bond, and ligand field theories are developed using symmetry and group theory. Selected main group, transition metal, and organometallic compounds are discussed. An introduction to crystallography and solid-state structure is included.
Fall, 3 credits, Letter graded (A, A-, B+, etc.)

CHE 514: Transition Metal Chemistry
A survey course with an emphasis on the transition metals. Reaction mechanisms, synthesis, and structure are covered. Specific areas of concern include coordination chemistry, organometallic chemistry, bioinorganic chemistry, and selected topics.
from solid-state and non-transition metal chemistry.

Spring, 3 credits, Letter graded (A, A-, B+, etc.)

CHE 515: Advanced Inorganic Chemistry
A topical course with an emphasis on the current literature. Subject matter varies and is announced in advance. Possible subjects include reaction mechanisms, organometallic chemistry, bioinorganic chemistry, and physical inorganic chemistry. May be repeated as the subject matter varies.

Spring, 3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

CHE 516: Solid-State Chemistry
This course will provide an introduction to structure and bonding in solid materials. This class will survey the important structural classes of periodic solids and will discuss space groups and the crystallographic symmetry elements important to these materials. Topics that will be covered may include, but are not limited to: (i) The mechanisms by which crystals grow and common types of defects. (ii) An introduction to the basics of band theory. (iii) An overview of the important synthetic methods for preparing solid state materials in nanocrystalline, powder, thin film, and single crystal form. (iv) A survey of the important techniques for assessing the composition, homogeneity, and crystallinity of materials (such as SEM, TEM, AFM, STM), with an emphasis on powder x-ray diffraction.

Fall, 3 credits, Letter graded (A, A-, B+, etc.)

CHE 517: Structural Chemistry
Much of chemistry is concerned with the properties of atoms and molecules that are too small to see directly. This course will cover a variety of advanced techniques for elucidating the atomic-scale structure of molecules and periodic solids. A central technique is diffraction, which probes periodic arrays. The mathematical basis for diffraction will be presented, followed by practical examples of obtaining atomic coordinates from diffraction data (powder and/or single crystal). Other techniques that may be covered include the analysis of local structure in partially ordered or disordered solids (via techniques such as PDF, EXAFS, small angle scattering, or solid state NMR), and the basis of more complex diffraction experiments (neutron/ electron diffraction, energy-dispersive/Laue diffraction, and diffraction under extreme pressure/temperature conditions).

Spring, 3 credits, Letter graded (A, A-, B+, etc.)

CHE 518: Materials Chemistry
Our high technology world is driven forward by advances in materials chemistry. This class will discuss the origin of this technology, covering the synthesis, structures, and properties of advanced materials. These materials will be studied from a multidisciplinary perspective, since the knowledge required for their development spans more than one traditional academic discipline. This class will focus on broad topics with great current societal importance (energy, computing, nanoscience, etc.), and will discuss the materials at the heart of our present technology as well as novel classes of materials being developed for future technology applications. Specific topics may include batteries, fuel cells, catalysts, metallic conductors, semiconductors, superconductors, permanent magnets, magnetic films.

Spring, 3 credits, Letter graded (A, A-, B+, etc.)

CHE 519: Electrochemistry and Electrochemical Materials Science
This course will survey electrochemistry and electrochemical materials science. Topics will include fundamental measurements in electrochemistry, galvanostatic and potentiostatic methods, the electrochemical double layer, corrosion and passivation. Relevant applications such as fuel cells, batteries, and supercapacitors will be discussed.

Spring, 3 credits, Letter graded (A, A-, B+, etc.)

CHE 520: Quantum Chemistry I
Quantum theoretical concepts are discussed. Schrödinger wave mechanics and related mathematical techniques are illustrated by treatment of systems of chemical interest. Designed to form the theoretical basis for the study of chemical bonding, molecular structure, spectroscopy, and molecular collision phenomena.

Fall, 3 credits, Letter graded (A, A-, B+, etc.)

CHE 521: Quantum Chemistry II
A detailed description of the theory and practice of molecular spectroscopy. Topics include the interaction of molecules with electromagnetic radiation and the time evolution of molecular energy states.

Prerequisite: CHE 520

Spring, 3 credits, Letter graded (A, A-, B+, etc.)

CHE 522: Molecular Spectroscopy
A detailed description of the theory and practice of molecular spectroscopy. Topics include the interaction of molecules with electromagnetic radiation and the time evolution of molecular energy states.

Prerequisite: CHE 521

Spring, 3 credits, Letter graded (A, A-, B+, etc.)

CHE 523: Chemical Thermodynamics
A rigorous development of the fundamentals of thermodynamics and its application to a number of systems of interest to chemists, such as electrochemical cells, gases, and homogeneous and heterogeneous equilibrium. An introduction to statistical mechanics will also be included.

Fall, 1-3 credits, Letter graded (A, A-, B+, etc.)

CHE 524: Magnetic Resonance
This course provides an introduction to the fundamental quantum mechanics of the magnetism of spin-1/2 (and higher) particles. It includes a study of the Bloch equations (the responses of the magnetism to continuous- wave and pulsed irradiation) and a discussion of the experimental hardware and techniques commonly employed. Topics covered include the basics of the spin Hamiltonian (chemical shifts, J, dipolar, and quadrupolar couplings), dynamics and relaxation 1-D spectroscopy (spin and chemical exchange, lineshapes, spin echoes, etc.), 2-D spectroscopy (homonuclear and heteronuclear correlation), techniques for studies of solids and liquid crystals (magic angle spinning, cross polarization, quadrupolar echo), and the principles of magnetic resonance imaging. Applications to the biological and material sciences, as well as chemical problems, will be discussed.

Spring, alternate years, 3 credits, Letter graded (A, A-, B+, etc.)

CHE 525: Theoretical Chemistry
This course stresses the physical theory underlying chemical phenomena. Special emphasis is given to advanced topics in electronic structure theory, molecular dynamics, condensed matter and surfaces, many-body and quantum ensemble theory, and the interaction of light and molecules.

3 credits, Letter graded (A, A-, B+, etc.)

CHE 528: Statistical Mechanics
Statistical theory of equilibrium systems and rate processes. Ensemble theory, spatial and time correlation functions. Model systems and methods of estimating their properties. Designed to enable the student to use the current literature dealing with application of statistical mechanics to problems in chemistry.

Spring, 3 credits, Letter graded (A, A-, B+, etc.)

CHE 529: Quantitative Analysis of Materials
This course provides a brief overview of several quantitative approaches to characterizing materials, including small-angle X-ray and neutron scattering (SAXS/
SANS), fitting scattering data, colloidal phase behavior, dynamic light scattering (DLS), light scattering microtomeography, crystallography and diffraction, grazing-incident small-angle scattering (GISAXS), X-ray correlation photon spectroscopy (XPCS), and X-ray imaging and microscopy.

Spring, 0–3 credits, Letter graded (A, A-, B+, etc.)

CHE 530: Physical Chemistry of Macromolecules

An investigation of the gross and fine structures of macromolecules and molecular aggregates in solution as revealed by hydrodynamic behavior (e.g., ultracentrifugation, viscosity), light scattering, spectroscopic properties (e.g., ultraviolet hypochromism, circular dichromism, Raman, fluorescence, magnetic resonance spectra), and the thermodynamics and kinetics of interaction with small molecules and ions. Theory of conformation changes and phase transitions.

3 credits, Letter graded (A, A-, B+, etc.)

CHE 534: Computing in Chemistry

The basic elements of scripting, design of computer programs, and numerical analysis are discussed within the framework of solving a variety of exciting problems chosen from all areas of chemistry. Topics include automation of repetitive tasks, fitting of data, numerical integration of rate equations, signal and image analysis, and quantum chemistry. No previous knowledge of computer programming is assumed.

Fall, 3 credits, Letter graded (A, A-, B+, etc.)

CHE 535: Introduction to Computational Structural Biology and Drug Design

This course will provide an introduction to Computational Structural Biology with application to Drug Design. Methods and applications that use computation to model biological systems involved in human disease will be emphasized. The course aims to foster collaborative learning and will consist of presentations by the instructor, guest lecturers, and by course participants with the goal of summarizing key methods, topics, and papers relevant to Computational Structural Biology.

Fall, 0–3 credits, Letter graded (A, A-, B+, etc.)

CHE 536: Molecular Modeling of Biological Molecules

This course is designed for students who wish to gain hands-on experience modeling biological molecules at the atomic level. In conjunction with the individual interests, Molecular Mechanics, Molecular Dynamics, Monte Carlo, Docking (virtual screening), or Quantum Mechanics software packages can be used to study relevant biological system(s). Projects will include setup, execution, and analysis. Course participants will give literature presentations relevant to the simulations being performed and a final project report will be required. Familiarity with UNIX (Linux) is desirable.

Prerequisite: CHE 535 or permission of instructor
Spring, 0–3 credits, Letter graded (A, A-, B+, etc.)

CHE 541: Biomolecular Structure and Analysis

The structures of biological macromolecules and the relationship of their structure to biological function are described. Methodology employed to study macromolecules is also discussed. Topics include chemical and physical properties of cell and tissue constituents, including carbohydrates, lipids, nucleic acids, proteins and peptides. May not be taken by students with credit for MCB 520. Prerequisite: Strong foundation in physical and organic chemistry.

Fall, 3 credits, Letter graded (A, A-, B+, etc.)

CHE 542: Chemical Biology

The reactivity and physiological function of biological macromolecules and their cofactors are described at the chemical biochemical level. The emphasis of this course reflects recent advances in chemical biology. Possible topics include catalysts, reaction mechanisms, correlation between three-dimensional structure and reactivity, receptor-ligand interactions in extracellular and intracellular signaling, protein folding in vitro and in vivo.

Spring, 3 credits, Letter graded (A, A-, B+, etc.)

CHE 543: Chemical Approaches to Biology

The use of molecular concepts and methodology to solve problems in biology and medicine. The course covers methods to elucidate and control biological systems. Possible topics include chemical genomics, metabolomics, and chemotherapeutics.

Prerequisite CHE 542
Fall, 3 credits, Letter graded (A, A-, B+, etc.)

CHE 548: Physical Biology

This is a course on the principles of physical chemistry. We describe the nature of the forces and energies and entropies that drive molecular systems toward their states of equilibrium. We consider a broad range of applications throughout chemistry, biology, materials engineering and nanoscience. This course aims to give students an understanding of how the actions and behaviors of materials arise from their atomic and molecular structures. Co-listed with PHY 558

Spring, 3 credits, Letter graded (A, A-, B+, etc.)

CHE 559: Biological Dynamics and Networks

This course will provide a solid foundation in key theoretical concepts for the study of dynamics in biological systems and networks at different scales ranging from the molecular level to metabolic and gene regulatory networks. Topics of this course include but are not limited to: Physical kinetics; Diffusion/Smoluchowski; Random flights; Waiting times; Poisson; Brownian ratchets; Chemical kinetics; Transition states; Stability, bifurcations, pattern development; Noise in cells: intrinsic and Extrinsic; Feedback; Biological Oscillators; Recurrence, period doubling, chaos; Networks; Topologies; Degree distribution, betweenness; Models of nets: Erdos-Renyi, scale-free, social, Watts- Strogatz, agents; Robustness, highly-optimized tolerance, bowties, epidemics; Biological networks: Protein-protein nets, regulatory and metabolic nets; Known biological circuits and their behaviors; How networks evolve: Preferential attachment, rewiring; Power laws; Fluxed through networks; Information and communication, entropy; Metabolic flux analysis; Artificial and Natural selection for traits; Darwinian evolution; Population dynamics.

Spring, 3 credits, Letter graded (A, A-, B+, etc.)

CHE 561: Departmental Research Seminar

Meetings in which first-year graduate students learn about the research activities of the departmental faculty.

Fall, S/U grading

CHE 582: Literature Seminar

Students select and discuss topics from the current literature.

Spring, Letter graded (A, A-, B+, etc.)

CHE 586: Professional Skills for Scientists

Development and refinement of the professional skills used by scientists: An exploration of more sophisticated presentation skills used in oral and poster presentations; incorporation of collaborative problem solving that mimics real world situations.
including simple proposal writing; exposure to professional societies and meetings; an exploration of career options and employment resources; tips for resume preparation and interviews. Recommended for upper division undergraduates and masters students. Winter, 2 credits, ABCF Grading

2 credits, Letter graded (A, A-, B+, etc.)

**CHE 588: Graduate Workshop**

Additional problem solving and team learning on topics from a concurrent formal graduate course. Topics vary.

Fall and Spring, 0-1 credits, S/U grading

May be repeated for credit.

**CHE 589: Directed Study**

Subject matter varies according to needs of student.

Fall and Spring, 0-12 credits, Letter graded (A, A-, B+, etc.)

May be repeated for credit.

**CHE 590: M.S. Term Paper**

Seminar leading to a term paper on a selected topic in chemistry, chemical applications, or chemical pedagogy.

Fall, Spring, 3 credits, Letter graded (A, A-, B+, etc.)

May be repeated for credit.

**CHE 591: Chemistry of the Environment**

This course provides an overview of the chemistry of environmental processes, environmental degradation, remediation and abatement processes, and energy production. Past actions and current efforts of the chemical enterprise in both exacerbating and addressing anthropogenic environmental degradation are discussed.

3 credits, Letter graded (A, A-, B+, etc.)

**CHE 593: Chemical Demonstrations**

The design and implementation of demonstrations to illustrate modern concepts of chemistry.

3 credits, Letter graded (A, A-, B+, etc.)

**CHE 596: Teaching and Learning Chemistry**

The objective of CHE 596 is to better prepare students for the kinds of interactions they are likely to have in their careers when communicating their chemistry. Specifically, this course will help students to: (i) develop competency with research-based approaches to facilitating discourse that is generative for improving scientific understandings of chemistry phenomena; (ii) recognize the importance of representations in chemistry and to incorporate a more explicit modeling perspective and approach for developing scientific literacy; (iii) develop teaching strategies to effectively communicate abstract and complex chemical concepts to advise expert and non-expert audiences; (iv) develop curricular interventions aimed at improving individual and community practice of challenging conceptual ideas; (v) incorporate historical and philosophical perspectives on the development of fundamental chemical principles into the teaching of those topics in diverse settings; (vi) become aware of recent developments in the learning progressions literature to inform understanding of appropriate curriculum planning and implementation; and (vii) develop an identity towards reflective practice and empowerment of fellow chemistry educators into positions of leadership.

3 credits, Letter graded (A, A-, B+, etc.)

**CHE 597: M.S. Research Thesis Development**

This course provides a structured environment for students to develop their research project into a written thesis. Students will receive instruction and guidance in performing literature research related to their project and in developing this background material along with their own research into a properly written document.

3 credits, S/U grading

May be repeated for credit.

**CHE 598: Professional Masters Internship**

Participation in private corporations, public agencies, or non-profit institutions for research and other experiential training activities related to the completion of a Master term paper. Students will be required to have a faculty coordinator as well as a contact in the outside organization, to participate with them in regular consultations on the project, and to successfully complete CHE 590. Prerequisites: Permission of Master's Program Director. 0-12 credits, S/U grading May be repeated for credit

Offered

Fall, Spring, and Summer, 0-12 credits, S/U grading

May be repeated for credit.

**CHE 599: Research**

Fall, Spring, 1-12 credits, S/U grading

May be repeated for credit.

**CHE 602: Special Topics in Physical Organic Chemistry**

The subject matter varies depending on interests of students and staff. It may cover such areas as photochemistry, theoretical organic chemistry, and the chemistry of unstable intermediates; the emphasis is on fundamental considerations and recent developments.

1-12 credits, Letter graded (A, A-, B+, etc.)

May be repeated for credit.

**CHE 603: Special Topics in Bioorganic Chemistry**

The subject matter varies depending on interests of students and faculty. Possible topics include asymmetric synthesis and natural product synthesis.

Fall, 1-3 credits, Letter graded (A, A-, B+, etc.)

May be repeated for credit.

**CHE 606: Special Topics in Synthetic Chemistry**

May be repeated for credit.

**CHE 607: Modern Drug Design & Discovery**

A seminar course covering modern aspects and approaches to drug design. This course combines presentations by faculty and by industry representatives to provide a cross-disciplinary view of the development of pharmaceuticals.

Fall, 1-3 credits, Letter graded (A, A-, B+, etc.)

**CHE 610: Practicum in Teaching**

Practice instruction in chemistry at the undergraduate level, carried out under faculty orientation and supervision. A minimum of two semesters of CHE 610 or 611 is required of all candidates for graduate research degrees in chemistry, unless explicitly waived by the chairperson.

Fall and Spring, 1-3 credits, Letter graded (A, A-, B+, etc.)

May be repeated for credit.

**CHE 611: Practicum in Teaching**

Practice instruction in chemistry at the undergraduate level, carried out under faculty orientation and supervision. A minimum of two semesters of CHE 610 or 611 is required of all candidates for graduate research degrees in chemistry, unless explicitly waived by the chairperson.

Fall and Spring, Letter graded (A, A-, B+, etc.)

May be repeated for credit.

**CHE 619: Critical Readings of Current Topics in Chemistry**

Recent research papers from the literature will be analyzed in depth. These papers may originate from the inorganic, organic, physical, and/or biochemical literature. The exact topic
CHE 695: Inorganic Chemistry Seminar
Fall and Spring, 0-12 credits, S/U grading
May be repeated for credit.

CHE 696: Organic Chemistry Seminar
Fall and Spring, 0-12 credits, S/U grading
May be repeated for credit.

CHE 697: Seminar in Physical and Quantitative Biology
Fall and spring, 0-1 credits, S/U grading.
0-1 credits, S/U grading
May be repeated 1 times FOR credit.

CHE 698: Colloquium
Fall and Spring, 0-12 credits, S/U grading
May be repeated for credit.

CHE 699: Dissertation Research on Campus - Domestic
Prerequisite: Must be advanced to candidacy (G5). Major portion of research must take place on SBU campus, at Cold Spring Harbor, or at the Brookhaven National Lab.
Fall, Spring, and Summer, 1-9 credits, S/U grading
May be repeated for credit.

CHE 700: Dissertation Research off Campus - International
Prerequisite: Must be advanced to candidacy (G5). Major portion of research will take place outside of the United States and/or U.S. provinces. Please note, Brookhaven National Labs and the Cold Spring Harbor Lab are considered on-campus. All international students must enroll in one of the graduate student insurance plans and should be advised by an International Advisor.
Fall, Spring, 1-9 credits, S/U grading
May be repeated for credit.

CHE 701: Dissertation Research off Campus - International
Prerequisite: Must be advanced to candidacy (G5). Major portion of research will take place outside of the United States and/or U.S. provinces. Domestic students have the option of the health plan and may also enroll in MEDEX. International students who are not in their home country are not covered by mandatory health plans and must contact the Insurance Office for the insurance charge to be removed. International students who are not in their home country are not covered by mandatory health insurance. If they are to be covered by another insurance plan they must file a waiver for second week of classes. The charge will only be removed if other plan is deemed comparable.

CHE 800: SUMMER RESEARCH
May be repeated for credit.

CHI

Chinese Language

CHI 501: Advanced Chinese I
An advanced course in Chinese as a foreign or heritage language to strengthen their ability to understand, speak, read, and write Chinese beyond the intermediate level. Students learn to read and comprehend a variety of texts from Chinese newspaper/magazine articles, TV/films, and literary works and to write creatively and professionally in Chinese using sophisticated vocabulary and advanced Chinese characters. Students will also be trained to comprehend authentic spoken Mandarin Chinese, using a variety of audio-visual materials and to communicate in Mandarin Chinese, applying appropriate socio-cultural norms.
3 credits, Letter graded (A, A-, B+, etc.)

CHI 502: Advanced Chinese II
The second part of an advanced course in Chinese as a foreign or heritage language to strengthen their ability to understand, speak, read, and write Chinese beyond the intermediate level. Students learn to read and comprehend a variety of texts from Chinese newspaper/magazine articles, TV/films, and literary works and to write creatively and professionally in Chinese using sophisticated vocabulary and advanced Chinese characters. Students will also be trained to comprehend authentic spoken Mandarin Chinese, using a variety of audio-visual materials and to communicate in Mandarin Chinese, applying appropriate socio-cultural norms. This course is not intended for students who already speak Chinese natively.
3 credits, Letter graded (A, A-, B+, etc.)

CHI 511: Readings: Journalistic Chinese
Narrative readings in Chinese selected from Chinese newspapers and magazines, including news reports and narratives on lifestyles, people, and landscapes. Students are expected to improve their skills in the analysis and writing of narrative readings. This course is designed for students who already have advanced level proficiency in Chinese, who can read and write everyday vernacular
CHI 512: Readings in Classical Chinese
Introduction to writings in Chinese that appeared before the May 4th Movement (circa 1920), which marked the beginning of modern Chinese. The course introduces students to readings in classical Chinese and to acquaint students with cultures and customs of traditional China. This course is designed for students who already have advanced level proficiency in Chinese, who can read and write everyday vernacular Chinese, but who have not been exposed to more formal language and literary forms.

3 credits, Letter graded (A, A-, B+, etc.)

CHI 521: Chinese Poetry & Short Stories

CHI 526: Structure of Mandarin Chinese
Mandarin Chinese is only one of a very few contemporary languages whose history is documented in an unbroken tradition extending back to the second millennium BC. At the same time, it has more speakers than any other language spoken in the modern world. This course provides an introduction to the phonology, morphology, syntax, semantics, and writing system of the Mandarin Chinese language. It is designed to familiarize students with some fundamental knowledge of the structure of spoken and written Mandarin Chinese. Specifically, it aims to enable the students to acquire an understanding of basic methods used by linguists to observe and gather Mandarin Chinese data, to delineate structural properties with regard to the sound, tone, word, grammar, and discourse of the language, and to develop a basic typological comparison between Mandarin Chinese and English.

3 credits, Letter graded (A, A-, B+, etc.)

CHI 545: Learning of Asian Languages
This course will analyze the cognitive processes involved in the acquisition of Asian languages as second or foreign languages. We will start with a discussion of first language acquisition and compare it with second language acquisition (SLA). Methodologies such as contrastive analysis and error analysis, and concepts such as interlanguage, native and non-native competence, bilingual competence, acceptability, correctness, standard language will be critically examined. We will also consider the variables that affect SLA, including age, context, exposure, attitude, cognition, attention and motivation. Special attention will be given to the applicability of current research paradigms and findings to the acquisition of languages such as Chinese, Japanese, Korean, and Hindi, both in terms of their structural characteristics and in their socio-cultural context.

3 credits, Letter graded (A, A-, B+, etc.)

CIV 505: Transportation Network Analysis
Traffic flows on networks; Deterministic and user equilibrium traffic assignment problems; Transportation networks and optimality; Transportation network design and reliability; Vulnerability of transportation networks

3 credits, Letter graded (A, A-, B+, etc.)

May be repeated for credit.

CIV 507: Transportation Economics
Microeconomics principles applied in the transportation field. Transportation demand and supply. Transportation costs (fixed costs, variable costs) and externalities. Economic and social benefits of transportation. Economic principles for transport pricing, e.g. toll pricing. Cost benefit analysis of a transportation project. History of government regulation of transportation.

3 credits, Letter graded (A, A-, B+, etc.)

CIV 509: Transportation Logistics Systems
This course provides a deep understanding of logistics systems by introducing the models and analytic techniques to evaluate their design and operation. Emphasis will be placed on the development of models to demonstrate the core concepts involved in network distribution strategies, discrete facility location design, vehicle routing and scheduling, and inventory management.

3 credits, Letter graded (A, A-, B+, etc.)
polymers. The students then take field trips as a group to concrete batch plant, construction sites, or LEED-certified building with innovative concrete use and have a presentation about their field trips. Semesters Offered: Spring 3 credits, Letter graded (A, A-, B+, etc.) May be repeated 1 times FOR credit.

CIV 515: Analysis of Deep Foundations
This course covers topics related to the analysis and design of deep foundations including the design of vertically loaded drilled shafts and driven piles, the analysis of laterally loaded piles, and in-situ pile load tests. 3 credits, Letter graded (A, A-, B+, etc.)

CIV 516: Soil and Site Improvement
This class will expose students to techniques currently used in practice to improve the properties of soils in-situ. These techniques will include shallow and deep compaction, overexcavation and replacement, deep replacement, drainage and dewatering, preloading, deep soil mixing, and fill reinforcement. At the end of the class, students will be able to perform preliminary analysis to select the most appropriate soil improvement technique for a given project and deliver a detailed design of the selected technique. 3 credits, Letter graded (A, A-, B+, etc.)

CIV 517: Engineering Geology
Engineering geology is a multidisciplinary field that views geology from a civil engineering perspective. In this course, students will first learn how to characterize rocks and sediments as natural and engineering materials. Then, they will have a review over structural geology, geologic and engineering description of rock masses (geologic mapping, joint surveys, brief description of exploration techniques). Through case studies on different terrains (glacial, shore, alluvial, etc), students will explore how geology influences the design and construction of civil engineering projects. Prevention and mitigation of geohazards will also be discussed, along with the characteristics of different terrains. 3 credits, Letter graded (A, A-, B+, etc.)

CIV 522: Introduction to Coastal Engineering
Basic hydrodynamics of water waves. Topics include linear wave theory, energy, power and energy propagation, wave refraction, shoaling and breaking in the nearshore, diffraction by breakwaters and gaps, reflection and basin oscillations, wave statistics and spectra, wind-wave hindcast/forecast, wave forces on piles and pipes. Some coastal processes due to nonlinearity, including wave set-up/set-down, nearshore circulations and storm surges. Physical interpretations of mathematical formulas are particularly emphasized. Semesters Offered: Spring 3 credits, Letter graded (A, A-, B+, etc.) May be repeated 1 times FOR credit.

CIV 523: Coastal Engineering Planning and Design
The basic principles involved in the planning and design of various types and functions of coastal structures and shore protective measures will be discussed. Topics will include review of linear wave theory, considerations of site conditions; design processes; design of sloping- and vertical-face coastal structures; scour and scour protection; coastal sediment transport; shore protection measures such as coastal armoring, beach restoration, and beach stabilization; and introduction to harbor and marina. 3 credits, Letter graded (A, A-, B+, etc.)

CIV 524: Coastal Processes and Sediment Transport
This course describes processes associated with water and sediment movements close to shoreline. The topics covered in this course includes: sediment characteristics; long-term processes, hydrodynamics of coastal zone; field measurement techniques and analysis, equilibrium beach profiles, sediment transport, modeling of beaches and shorelines, shoreline modification and analysis including soft and hard engineering approaches and tidal inlets. 3 credits, Letter graded (A, A-, B+, etc.)

CIV 525: Environmental Biotechnology
This graduate course covers the fundamental concepts of biological processes that are important in natural and engineered environmental systems. The course will incorporate basic fundamental microbiology into a quantifiable engineering context in order to describe, predict and control behavior of environmental biological system. 3 credits, Letter graded (A, A-, B+, etc.)

CIV 530: Structural Mechanics
This course deals with fundamentals of the theory of structures with the objective of providing proper understanding and knowledge on structural analysis methods and structural behavior. The subject treatment is in the context of truss, beam, frame, and plate structural elements. A key objective is to provide the necessary knowledge and skills for capturing structural behavior through simple models. The course will extend concepts in matrix structural analysis by presenting a general framework for analyzing complex structural systems. A brief introduction to the finite element method and nonlinear structural analysis is provided. 3 credits, Letter graded (A, A-, B+, etc.)

CIV 531: Nonlinear Structural Mechanics
The course is aimed at advanced MS students and PhD students, and will complement other core courses in the sub-discipline of Structural Engineering and Mechanics. The course is designed as a follow-up from an existing fundamental introductory course: CIV 530 (Structural Mechanics). A justification on the importance of the topic for the training of students in the area of structural engineering and mechanics is given below. While the behavior of most structures under service loads is adequately captured by linear elastic analyses, their response near ultimate conditions is most often nonlinear. These limit-state conditions include the effects of cumulative elastic deformations that may lead to system instability (i.e., buckling), the effect of material inelastic response (e.g., yielding, or crushing) near ultimate capacities, or the combination of both. The area dealing with the theory and methods to determine the response of structures through their nonlinear behavior is commonly termed nonlinear structural mechanics. This advanced subject matter has become more conventional as the increase in computer power and increasingly user-friendly software is allowing more engineers to make use of the advantages of nonlinear analysis. These include load redistribution after plasticization, design of structural systems for specific performance levels (beyond linear-elastic state), design of reconfigurable and deployable structures, and the determination of collapse behavior under extreme events. The course will present relevant theory and analysis methods on geometric and material nonlinear behavior of structures. Concepts will be presented from first principles but their application will be focused on truss and beam/frame finite elements. Assignments include computer program development and use of existing commercial computer codes. 3 credits, Letter graded (A, A-, B+, etc.)

CIV 532: Structural Dynamics
Analysis of the dynamic response of structures and structural components to transient loads and foundation excitation; single-degree-of-freedom and multi-degree-of-freedom systems; response spectrum concepts; numerical methods for integration of the equations of motion; simple inelastic structural systems; systems with distributed mass and flexibility.
3 credits, Letter graded (A, A-, B+, etc.)

CIV 533: Intermediate Steel Design
Metal members under combined loads; connections, welded and bolted; moment-resistant connections; plate girders, conventional behavior, and tension field action.
3 credits, Letter graded (A, A-, B+, etc.)

CIV 534: Intermediate Reinforced Concrete Design
Strength, behavior, and design of indeterminate reinforced concrete structures, with primary emphasis on slab systems; emphasis on the strength of slabs and on the available methods of design of slabs spanning in two directions, with or without supporting beams.
3 credits, Letter graded (A, A-, B+, etc.)

CIV 535: Earthquake Engineering
Source mechanisms, stress waves, and site response of earthquake shaking; effect on the built environment; nature of earthquake actions on structures; fundamental structural response characteristics of stiffness, strength, and ductility; representation of the earthquake input in static and dynamic structural analysis; modeling of steel and concrete structures under earthquake effects; outputs for safety assessment; comprehensive source-to-design actions project.
3 credits, Letter graded (A, A-, B+, etc.)

CIV 540: Intermediate Computational Mechanics
This course deals with some intermediate computational mechanics concepts and is a continuation of introductory finite element courses. The main objective is to provide proper understanding and knowledge on theoretical and practical aspects of finite element technology. Emphasis is placed on time dependent problems, nonlinear elasticity, stress update algorithms, mixed and penalty formulations, as well as computer implementation and programming concepts.
3 credits, Letter graded (A, A-, B+, etc.)

CIV 544: Environmental Fluid Dynamics
Free surface flows of water and air occurring in natural fluid systems and influencing environmental transport and mixing. Fundamental principles of fluids, covering the scales relevant to both engineering and geophysical applications. Topics include waves, instability, stratification, turbulent boundary layers, jets and plumes, and river hydraulics.
3 credits, Letter graded (A, A-, B+, etc.)

CIV 545: Computational Fluid Dynamics
Computational methods in hydraulics and coastal engineering, Incompressible flows, Turbulence modeling, Coupled hydrodynamics and Morphodynamics, Computational methods for modeling contaminant transport, Numerical algorithms for solving Navier-Stokes equations, Introducing parallel programming and high-performance computing in computational fluid dynamics.
3 credits, Letter graded (A, A-, B+, etc.)

CIV 546: Environmental Aquatic Chemistry
This course introduces the application of physical chemistry to solve problems related to natural water systems (both freshwater and seawater) and anthropogenic impacts on these systems. We will cover thermodynamics and kinetics and how they can be used to understand the distribution and cycling of chemical species in natural waters and related processes, including dissolution and precipitation, oxidation and reduction, acid-base interactions, and complexation. We will also cover special topics related to current issues in water quality.
3 credits, Letter graded (A, A-, B+, etc.)

CIV 547: Environmental Physical-Chemical Processes
Physical-chemical processes that affect environmental quality in natural and engineered systems. The focus is on developing a qualitative understanding of mechanisms as well as quantitative tools to describe, predict, and control physical-chemical processes. Topics include reactor mixing and reaction kinetics, gas transfer, sorption, particle dynamics, filtration, membranes, and disinfection. Most of the applications are in the water quality sub-domain, but overlap exists with air quality, soil and sediment contamination, and even some applications to biological systems.
3 credits, Letter graded (A, A-, B+, etc.)

CIV 548: Organic Pollutants in Environmental Systems
This course covers topics in theoretical and applied environmental organic chemistry. We will focus on physical/chemical properties of organic pollutants and the processes that govern their fate and transport, particularly in air and water, as well as their interactions with soil and biota. Topics include equilibrium partitioning, molecular diffusion, air-water exchange, sorption, bioaccumulation and biomagnification, and transformation reactions. We will also touch on emerging issues involving novel organic contaminants.
3 credits, Letter graded (A, A-, B+, etc.)

CIV 549: Environmental Exposure and Risk Assessment
This course will introduce types of harmful pollutants, the pathways by which humans and ecological receptors are exposed to these pollutants, and the strategies used to monitor and measure exposure and to estimate risk. We will explore the mechanisms linking chemical exposure to biological effects and how these processes are measured and modeled to characterize risks, as well as concepts related to environmentally-relevant exposures involving multiple stressors. Methodologies to quantitatively estimate ecological and human health risk will be discussed and applied to case studies covering real-life pollutant exposure scenarios.
3 credits, Letter graded (A, A-, B+, etc.)

CIV 550: Introduction to Smart Infrastructure Systems
The course will include lectures that provide historical background of smart infrastructure systems, fundamental concepts of decision-making, data representation, sensing and actuation networks, and associated challenges specific to smart cities applications. Basics concepts of probability and statistics, optimization, and uncertainty and risk will be introduced to help students build a solid foundation for machine learning and engineering system modeling. The course includes assignments that will provide hands-on experience on applying what they have learned from lectures. The students will conduct a comprehensive independent research project on topics related to smart infrastructure systems to enhance their understanding of a specific topic of their interest. This course will cover topics including sensing systems, data visualization, probabilistic modeling, Bayesian updating, convex optimization, uncertainty and risks, as well as open-ended topics related to policy, economics, and information security challenges in infrastructure monitoring and decision-making.
3 credits, Letter graded (A, A-, B+, etc.)

CIV 551: Sensing and Learning for Smart Cities
An introductory course on practical applications and challenges of sensing, data analytics and machine learning in the context of physical urban systems. Background is provided on data analysis and associated challenges specific to smart cities applications, insights behind signal representation, statistical modeling, and machine learning, and critical
**GRADUATE COURSE DESCRIPTIONS**

**Transportation Engineering**

- **CIV 680: Special Topics in Transportation Engineering**
  - 1-12 credits, S/U grading
  - This course is taken by M.S. students for their dissertation research. May be repeated for credit.

**Civil Engineering**

- **CIV 599: M.S. Thesis Research**
  - 0-9 credits, S/U grading
  - Students have to register for this class during their dissertation research after advancement to candidacy. Major portion of research must take place off-campus, but in the United States. May be repeated.

- **CIV 699: Dissertation Research On Campus**
  - 3 credits, S/U grading
  - Students have to register for this class during their dissertation research after advancement to candidacy. Major portion of research will take place off-campus, but in the United States. May be repeated.

**Materials and Geotechnical Engineering**

- **CIV 685: Special Topics in Materials Engineering**
  - The subject matter of special topics course can vary semester to semester depending on the interests of the students and the faculty, and the contemporary topics in materials engineering field.

**Systems and Environmental Engineering**

- **CIV 684: Special Topics in Water Resources and Environmental Engineering**
  - The course is designed for the discussion of topics of special interest on demand that may not be covered in regularly scheduled courses. Varying topics from water treatment, solid waste management, urban and watershed hydrology, stormwater management, water quality modeling to environmental fluid mechanics may be offered concurrently.

**Mechanics and Geotechnical Engineering**

- **CIV 681: Special Topics in Geomechanics and Geotechnical Engineering**
  - The subject matter of special topics course can vary semester to semester depending on the interests of the students and the faculty, and the contemporary topics in geotechnical engineering field.

**Ocean and Coastal Engineering**

- **CIV 686: Special Topics in Smart Civil Infrastructure Systems**
  - The subject matter of special topics course can vary semester to semester depending on the interests of the students and the faculty, and the contemporary topics in transportation field.

**Analytics for Engineering Systems**

- **CIV 555: Analytics for Engineering Systems**
  - This course systematically introduces methods of analytics with an emphasis placed on solving civil engineering problems. The design, operation, and management of civil engineering systems are increasingly complex and uncertain. This course aims to help students build the ability to use analytics for understanding, modeling, and optimizing civil engineering systems, and system of systems. Topics of this course include data description and visualization, modeling uncertainty with probability distribution, descriptive mining, sampling and statistical inference, regression analysis, time series analysis, neural networks, simulation, mathematical optimization, decision analysis, and optimization under uncertainty.

**Independent Study in Civil Engineering**

- **CIV 595: Independent Study in Civil Engineering**
  - Students can register this course in order to conduct research or participate in a project under the supervision of one or more members of the Civil Engineering faculty.

**MS Project**

- **CIV 596: MS Project**
  - This course is taken by M.S. students who select MS Project track. Conducted jointly by graduate students and one or more members of the faculty. A final project report must be submitted to the advisor as well as to the Graduate Program Director. Without the submitted report, credits from his course cannot be applied toward the MS degree.

**M.S. Thesis Research**

- **CIV 599: M.S. Thesis Research**
  - This course is taken by M.S. students for their thesis research work.

**MS Project**

- **CIV 682: Special Topics in Ocean and Coastal Engineering**
  - The course is designed for the discussion of topics of special interest on demand that may not be covered in regularly scheduled courses. Varying topics from ocean wave mechanics, offshore structures, coastal processes, sediments and morphology to estuarine dynamics may be offered concurrently.

**Seminar**

- **CIV 683: Special Topics in Structural Engineering**
  - The subject matter of special topics course can vary semester to semester depending on the interests of the students and the faculty, and the contemporary topics in structural engineering field.

**Practicum in Teaching II**

- **CIV 698: Practicum in Teaching II**
  - Practicum in teaching under faculty supervision 3 credits, S/U grading

**Dissertation Research On Campus**

- **CIV 699: Dissertation Research On Campus**
  - Students have to register for this class during their dissertation research after advancement to candidacy. Major portion of research must take place on SBU campus, at Cold Spring Harbor, or at the Brookhaven National Lab.

**Dissertation Research Off Campus-Domestic**

- **CIV 700: Dissertation Research Off Campus-Domestic**
  - Students have to register for this class during their dissertation research after advancement to candidacy. Major portion of research will take place off-campus, but in the United States.
States and/or U.S. provinces. All international students must enroll in one the graduate student insurance plans and should be advised by an international advisor.

1-9 credits, S/U grading
May be repeated for credit.

CLT 701: Dissertation Research Off Campus-International
Major Portion of research will take place outside of the United States and/or U.S. provinces. Domestic students have the option of the health plan and may also enroll in MEDEX. International students who are in their home country are not covered by mandatory health plan and must contact the Insurance Office for the insurance charge to be removed. International students who are not in their home country are charged for the mandatory health insurance. If they are to be covered by another insurance plan they must file a waiver second week of classes. The charge will only be removed if other plan is deemed comparable. All international students must receive clearance for an International Advisor

1-9 credits, S/U grading
May be repeated for credit.

CLT
Comparative Literature

CLT 501: Theories of Comparative Literature
This course provides a survey of literacy theory and its role in the formation of comparative literature as a discipline.

3 credits, Letter graded (A, A-, B+, etc.)

CLT 509: History of Literary Criticism
A history of literary theory from classical Greece to Freud. Offered Fall/ Spring, 3 credits, Letter graded (A, A-, B+, etc.)

CLT 597: Directed Readings for M.A. Students
A student and faculty member agree on a corpus of texts to read and discuss at weekly or biweekly meetings. The reading list must be filed with the program's form before the add/drop period ends. May be repeated for credit.
Fall and Spring, 1-3 credits, S/U grading
May be repeated for credit.

CLT 598: Thesis Research
Research and writing of M.A. thesis supervised by faculty advisor.
Offered Fall, Spring, 1-3 credits, S/U grading
May be repeated for credit.

CLT 599: Independent Study
A student and faculty member agree on a topic not offered in any seminars and a reading list to study at weekly or biweekly meetings. A final research paper or major annotated bibliography will be required. The syllabus must be filed with the program's form before the add/drop period ends. May be repeated for credit.

Only three credits of Independent Study can be counted toward the M.A. requirements, and a maximum of six toward the Ph.D
Fall and Spring, 1-3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

CLT 600: Seminar in Stylistics
Changing topics in the study of stylistic and structural elements of the literary text.
3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

CLT 601: Seminar in Literary and Cultural Theory
Changing topics in the specialized examinations of recent or historical trends such as semiotics, Marxism, reader-response, psychoanalysis, hermeneutics, deconstruction.
3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

CLT 602: Interdisciplinary Seminar
Specific problems in the relations between literature and other disciplines.
3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

CLT 603: Comparative Studies in Literary History
Changing topics in the study of literary periods and styles.
3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

CLT 604: Comparative Studies in Genre
Changing topics in the study of the history and theory of literary genres.
3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

CLT 605: MajorAuthors in Comparative Context
Critical and comparative examination of two or more major figures from different literary or other aesthetic traditions. Recent topics have included "Kristeva," Dostoevsky and the West," and "European Realisms." Offered Fall and Spring 3 Credits, ABCF Grading
3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

CLT 608: Cross-Cultural Perspectives
Key topics in genre, literary criticism, and methodology from a cross-cultural perspective. Emphasis will be placed on an examination of differences as well as similarities. Presuppositions of specific literary traditions will be questioned within the broader perspectives of philosophical and religious valences.
3 credits, Letter graded (A, A-, B+, etc.)

CLT 609: Advanced Topics in Comparative Literature
A variable topics seminar in Comparative Literature. 3 credits, Letter graded (A, A-, B+, etc.) Course may be repeated as topics vary. Semesters Offered: Fall and Spring
3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

CLT 680: Cultural Studies Research Seminar
In addition to readings on issues, debates, and problems within the profession and field of Cultural Studies students will develop research for publication while engaging with practices of professionalization.
Offered Fall/Spring, 3 credits, Letter graded (A, A-, B+, etc.)
May be repeated 2 times FOR credit.

CLT 690: Directed Readings for Doctoral Candidates
A student and faculty member agree on a corpus of texts to read and discuss at weekly or biweekly meetings. The reading list must be filed with the program's form before the add/drop period ends. May be repeated for credit.
Fall and Spring, 1-12 credits, S/U grading
May be repeated for credit.

CLT 696: Self-Directed Readings
For doctoral students who have completed all course requirements and wish to dedicate themselves to full or part-time preparation for the Comprehensive Examination.
Fall and Spring, 3-9 credits, S/U grading
May be repeated 6 times FOR credit.

CLT 698: Practicum in Teaching
The course is divided into two parts: one half is normally given in the fall, one in the spring. The first part deals primarily with matters of pedagogy. The second part is designed to help students plan their own undergraduate courses. The practicum is required of all students during their first year.
3 credits, Letter graded (A, A-, B+, etc.)
May be repeated 2 times FOR credit.

CLT 699: Dissertation Research on
Campus
Prerequisite: Advancement to candidacy (G5).
A portion of dissertation research must take
place on SBU campus.
Fall, Spring, and Summer, 1-9 credits, S/U grading
May be repeated for credit.

CLT 700: Dissertation Research off
Campus - Domestic
Prerequisite: Must be advanced to candidacy
(G5). Major portion of research will take place
off-campus, but in the United States and/or
U.S. provinces. Please note, Brookhaven
National Labs and the Cold Spring Harbor Lab
are considered on-campus. All international
students must enroll in one of the graduate
student insurance plans and should be advised
by an International Advisor.
Fall, Spring, 1-9 credits, S/U grading
May be repeated for credit.

CLT 701: Dissertation Research off
Campus - International
Prerequisite: Must be advanced to candidacy
(G5). Major portion of research will take place
outside of the United States and/or
U.S. provinces. Domestic students have the
option of the health plan and may also enroll
in MEDEX. International students who are
in their home country are not covered by
mandatory health plan and must contact the
Insurance Office for the insurance charge to
be removed. International students who are
not in their home country are charged for the
mandatory health insurance. If they are to be
covered by another insurance plan they must
file a waiver be second week of classes. The
charge will only be removed if other plan is
deemed comparable.
All international students must received
clearance from an International Advisor.
Fall, Spring, 1-9 credits, S/U grading
May be repeated for credit.

CLT 800: SUMMER RESEARCH
May be repeated for credit.

CLT 850: SUMMER TEACHING
May be repeated for credit.

CME
Chemical and Molecular
Engineering

CME 501: Fluid Mechanics
This course aims to provide graduate-level
students with fundamental concepts of fluid
mechanics; mass, energy and momentum
balances; fluids flow in pipes; Couette flows,
Poiseuille flows, unsteady flows; viscous flow;
fluid flow in porous media; laminar boundary
layer and other unidirectional flow; turbulent
flow; fluctuations and time-averaging, two
phase flow and fluidization; non-Newtonian
fluids; microfluidics and electro-kinetic flow
effects; compressible flows and computational
fluid dynamics.
3 credits, Letter graded (A, A-, B+, etc.)

CME 511: Transport Phenomena
This course covers topics in advanced
transport phenomena. Topics include,
equations of change for isothermal systems,
viscosity, momentum transport, laminar
and creeping flow, multi-variable velocity
potential, turbulent flow, Interphase transport,
friction factors, rheology of polymeric liquids,
non-Newtonian viscosity and generalized
Newtonian models, equations of change
for non-isothermal systems, temperature
distributions and unsteady heat conduction
in solids, temperature distributions in turbulent
flow and heat flux, diffusivity and mass
transport, mass and molar transport by
convection.
3 credits, Letter graded (A, A-, B+, etc.)

CME 512: Thermodynamics and
Transport in Physical and Chemical
Systems
This course provides in depth graduate level
instruction in thermodynamic properties of
physical and chemical systems, focusing on
transport and rate processes. Topics include
qualitative comparison of equilibrium and
non-equilibrium systems, the description
of thermodynamic ensembles, irreversible
processes, the concept of system fluctuations,
the equipartition principle, balance equations,
the Onsager relations, exergy analysis and its
applications, the Maxwell-Stefan equaion and
thermoecnomics. 3 credits, Letter graded (A,
A-, B+, etc.)
3 credits, Letter graded (A, A-, B+, etc.)

CME 513: Rheology
This course aims to provide graduate-level
students with an in-depth acquaintance with
important topics in rheology. Topics include
a discussion of the role of rheology in science
and engineering, the definition of viscosity, the
classification of various types of viscous fluids
and flows, deformation and stress, relaxation
functions, relaxation time, conversion among
response functions, complex modulus, glass
transition, time-temperature superposition rule,
WLF equation; stress expression in polymers,
tension, free-energy and distribution-function
of subchains, the Rouse and Zimm models,
derivation of stress and relaxation modulus,
discussion on the relaxation behavior, the
deGennes reptation model, and contour length
fluctuation in polymer chains. In addition to
the text, the student will be exposed to classic and current literature in the field.
3 credits, Letter graded (A, A-, B+, etc.)

**CME 514: Characterization Methods (Microscopy and Spectroscopy)**
This course aims to provide graduate-level students with an in-depth acquaintance with important characterization methods that are applicable to surface science, soft materials, thin films and nanotechnology. Topics include techniques such as atomic force microscopy (AFM) including contact-mode, tapping-mode and lateral-force AFM, scanning tunneling microscopy (STM), electrostatic force microscopy (EFM), magnetic force microscopy (MFM), AFM-based nano-lithography, surface force and adhesion measurement, as well as molecular recognition, X-ray photon spectroscopy (XPS) and ultraviolet photon spectroscopy (UPS), including basic principle, instrumentation configuration, data interpretation and analysis, chemical shift, quantification, and depth-profiling; time-of-flight secondary ion mass spectrometry (ToF-SIMS), Fourier-transform infrared spectroscopy (FTIR) and Raman spectroscopy, attenuated total reflection (ATR), diffuse reflectance, and polarization modulation-infrared reflection-adsorption spectroscopy (PM-IRRAS) and finally, scanning and transmission electron microscopy (SEM and TEM). In addition to the text, the student will be exposed to classic and current literature in the field.
3 credits, Letter graded (A, A-, B+, etc.)

**CME 515: Complex Fluids**
This course aims to provide graduate-level students with a unified approach to complex fluids. Complex fluids, also referred to as soft materials, have the capability to self-organize to form complex soft materials, are materials which have the fluid-like properties of fluids. Complex fluids, also referred to as soft materials, have the capability to self-organize to form complex soft materials, are materials which have the fluid-like properties of fluids.
3 credits, Letter graded (A, A-, B+, etc.)

**CME 519: Electrochemistry and Electrochemical Materials Science**
This course will survey electrochemistry and electrochemical materials science. Topics will include fundamental measurements in electrochemistry, galvanostatic and potentiostatic methods, the electrochemical double layer, corrosion and passivation. Relevant applications such as fuel cells, batteries, and supercapacitors will be discussed.
3 credits, Letter graded (A, A-, B+, etc.)

**CME 522: Heterogeneous Catalysis & Surface Reaction**
Heterogeneous catalysis is central to the petroleum chemical industry and it is directly related to products efficiency. This course will emphasize the fundamental and application of heterogeneous catalysis and introduce the catalytic reaction mechanism. Students who complete the course will have attained the following outcomes: 1) Basic understanding of catalyst and catalysis 2) Kinetics of heterogeneously catalyzed reaction 3) Surface characterization by spectroscopic techniques 4) Knowledge of supported metal oxide and zeolites 5) Application of theoretical calculations 6) Industrial applications of heterogeneous catalysis.
3 credits, Letter graded (A, A-, B+, etc.)

**CME 523: Nanocomposites**
This course aims to provide graduate-level students with an in-depth knowledge of the main types of nanocomposite materials and their specific physical and chemical properties required in applications. Topics include a discussion of the methods of preparation and characterization of specific physical properties of nanocomposite materials. The current state of theory and modeling of nanocomposites will be presented. At the end of the course, students will have enough understanding of the main concepts in nanocomposites physics, understand advantages and disadvantages of different thermoplastics and thermoset polymers as matrix materials. In addition students will gain the knowledge of different manufacturing techniques of nanocomposites. In addition to the text, the student will be exposed to classic and current literature in the field.
3 credits, Letter graded (A, A-, B+, etc.)

**CME 524: Chemical Processes in Cell Biology**
The course specially designed for chemical engineering students to provide an introduction to the various aspects of cell biology. The ideas of cell biology, including biochemistry and bioenergetics, DNA and protein synthesis, and mechanisms of cancer will be introduced.
3 credits, Letter graded (A, A-, B+, etc.)

**CME 525: Chemical and Biological Sensors**
Introduction to the field of chemosensor and biosensor, as well as an in-depth and quantitative view of the sensor design and performance analysis. Fundamental application of chemo/biosensor theory will be demonstrated including recognition, transduction, signal acquisition, and post processing/data analysis. Topics are selected to emphasize biomedical, bioprocessing, environmental, and energy application.
3 credits, Letter graded (A, A-, B+, etc.)

**CME 526: Computational Methods**
This course aims to provide graduate-level students with an in-depth acquaintance with use of modern computational and mathematical techniques in chemical engineering including applied numerical analysis, programming algorithms using mathematical software, and applications of computational methods to the solution of mechanical engineering. Topics include a discussion of the different analytical methods and algorithms and how to apply these using Matlab. In addition to the text, the student will be exposed to classic and current literature in the field.
3 credits, Letter graded (A, A-, B+, etc.)

**CME 527: Chemical and Biological Engineering**
Discussion of various phases of teaching, including preparation, classroom technique, and student evaluation. We will also explore skills and understanding necessary for mentoring of undergraduates and others involved in research.
1 credit, S/U grading
May be repeated for credit.

**CME 556: Synchrotron X-ray Analysis: Intro to Advanced Techniques for Chemical and Molecular Engineering**
In this course, world-leading experts from Brookhaven National Laboratory (BNL) will discuss advanced concepts
CME 590: Surfactants, dispersion technology and novel delivery vehicles

In the first part of the course the students will learn the structures of monomeric, polymeric, and biopolymeric surfactants. Students will be taught how to prepare and characterize surfactants. In the second part students will learn how surfactants arrange on surfaces and how they self-assemble in solution. Micellar solutions and their properties such as interfacial tension, aggregation number, and solubilization will be studied. Also, preparation of micro emulsions; solubilization of bioactives; stability/instability parameters, and thermodynamic stability/instability mechanism of emulsions, creaming, flocculation and coalescence will be discussed. In addition, steric and depletion stabilization will be discussed as well as double emulsions, their characterization and stabilization by biopolymers. Foams and solid in liquid will be explored and compared to emulsions. In the entire course examples from the cosmetic, cosmeceuticals and dermal and transdermal applications will be discussed. In the last part industrial and practical problems will be discussed.

3 credits, Letter graded (A, A-, B+, etc.)

CME 591: Sustainable Future Through Renewable Energy- Advanced

The course will expose students to the role of engineering, chemistry, climate change in defining energy options, and a basic understanding of chemical engineering and technology in developing broad energy options in developing countries. The course combines lectures with utilization of carbon management tools to calculate carbon footprint in a specific country in a virtual environment.

3 credits, Letter graded (A, A-, B+, etc.)

CME 594: Technical Writing for Chemical and Molecular Engineering

As a graduate student in Materials Science and Chemical and Molecular Engineering, you will be expected to do a considerable amount of writing, whether on your proposal, thesis, papers or presentations. All this writing will not end with your graduation either. Rather, it will continue into your workplace as you are called on to communicate your goals, project ideas, and technical know-how to others. This course is designed to help you find your voice in these communications. Toward this end, you will work on a series of short assignments that get to the crux of several writing tasks that you will need to do in your academic career and beyond. While there are many ways of going about writing, there are also many proven ways to facilitate the writing process. The goal for this semester is to discover how to make your writing clear, engaging and effective. In the process, it is expected that you will have attained the course outcomes detailed below.

0-3 credits, S/U grading
May be repeated for credit.

CME 595: CME MS Project Course

This course is taken by M.S. students who select MS Project (Non-thesis) track. Conducted jointly by graduate students and one or more members of the faculty. A final project report must be submitted to the advisor as well as to the Graduate Program Director. Without the submitted report, credits from this course cannot be applied toward the MS degree.

1-6 credits, Letter graded (A, A-, B+, etc.)
May be repeated 2 times FOR credit.

CME 599: Research

Offered Fall and Spring
0-9 credits, S/U grading
May be repeated for credit.

CME 695: CME MS Project Course

This course is taken by M.S. students who select MS Project (Non-thesis) track. Conducted jointly by graduate students and one or more members of the faculty. A final project report must be submitted to the advisor as well as to the Graduate Program Director. Without the submitted report, credits from this course cannot be applied toward the MS degree.

1-6 credits, Letter graded (A, A-, B+, etc.)
May be repeated 2 times FOR credit.

COM 501: Foundations of Science Communication I

An introduction to the Alda Method®, the Alan Alda Center®'s proprietary training approach to science communication, rooted in empathy and connection. Students experience
improvisation first hand to help them embrace flexibility while maintaining an appropriate level of preparation when presenting scientific information. The workshop nature of this course allows students to practice building connections with others through eye contact and body language, developing relevant analogies, sharing powerful examples, and storytelling. Students will learn to communicate scientific information with accuracy, integrity, and passion, to ensure it resonates with their audience.

1 credit, Letter graded (A, A-, B+, etc.)

COM 503: Foundations of Science Communication II
An extension of COM 501: Foundations of Science Communication I, students apply their foundational communication skills to develop and deliver compelling scientific presentations. Particular emphasis is placed on visual presentation strategies, allowing students the opportunity to practice using technology to complement and enhance their presentations, rather than detract from them. Students reflect on their own performance regularly, and also offer peer feedback to others. Prerequisite: COM 501
1 credit, Letter graded (A, A-, B+, etc.)

COM 516: Communication Research Methods
Inquiry into social science research that enables students to ask meaningful questions and conduct research to find reliable and valid answers to those questions. Students explore traditional and non-traditional data collection methods, tools for analysis, and current research trends. Students engage in the empirical research process by identifying research questions and hypotheses, reviewing past research, collecting and analyzing data, and evaluating the credibility of published research findings. As part of this course students will identify and delve more deeply into a content area within the Science of Communication field to build greater knowledge about how specific areas of science communication are interpreted, measured, and disseminated. Numerical and statistical concepts to analyze and interpret empirical data will be explored using a commonly used statistical package (e.g., Statistical Package for the Social Sciences, SPSS). Students will explore communication tactics and methods based in theory and practice. 3 credits, Letter graded (A, A-, B+, etc.)

COM 522: Communicating Science to Policy Makers
A hands-on experience that provides students with the skills, practice, and knowledge to clearly, concisely, and effectively communicate the importance of science to policy makers. Communication is essential to secure funding and successfully advocate for or against legislation that could greatly impact research. Learning how to effectively communicate science to state and federal elected officials and agency staff is crucial for scientists, healthcare professionals, and professional science communicators. Students will explore communication tactics and methods in theory and practice. 3 credits, Letter graded (A, A-, B+, etc.)

COM 526: Building and Assessing Communication Strategies
A comprehensive overview of strategic communication focused on advancing effective communication about science and related fields (e.g., health, technology, engineering, math) in institutionally diverse settings. Students learn to build and assess strategic communication campaigns based in 21st century communication practices. Grounded in ethics and the concept of principled public relations, students learn core skills and practice that enable them to work as effective science communication practitioners in an era of misinformation and information overload. Because project management is critical to advancing successful strategic communication efforts, students will also learn project management skills through the design and implementation of a targeted communication plan. 3 credits, Letter graded (A, A-, B+, etc.)

COM 534: Communicating Science Using Digital Media
An exploration into using digital platforms to communicate science to public audiences. Science and health information increasingly travels by digital media, as new ways emerge for scientists, health care professionals, and others to communicate directly with the public, without the intermediaries of press or public relations. Students will learn to be effective and engaged online communicators, to help science reach broader audiences in meaningful ways. This course offers a practical, hands-on approach to using digital "tools of the trade" such as blogs, videos, audio/podcasts, and social media platforms. Students will also learn about the great potential and perils of social media, as they learn to think critically about the broader issues surrounding this medium. 3 credits, Letter graded (A, A-, B+, etc.)
COM 577: Communication Law and Ethics
An exploration into the legal and ethical considerations that science communicators, journalists, mass media professionals, and consumers face in the 21st century. Students learn about the Society of Professional Journalists Code of Ethics, the First Amendment Handbook from the Reporters Committee for the Freedom of the Press, and review case studies and current newsworthy stories to build an analytical model through which they can understand, analyze, and act on relevant legal and ethical issues in public communication settings.
3 credits, Letter graded (A, A-, B+, etc.)

COM 583: Principles of Inclusive Engagement
An exploration of the role of communication in facilitating conversations that acknowledge and are inclusive of individual and group differences. Students will learn how individual and group differences can become disadvantages, the role of communication in developing responses to such disadvantages, and how differences can also become offers of discovery, development, and depth. Students will learn to engage others through communication that is inclusive, empathetic, and just. Among the techniques explored in this course are applied-improvisational theater exercises that will help students connect with others, pay close and dynamic attention, read nonverbal cues, respond freely, and work through nerves and self-consciousness in a variety of communication settings.
3 credits, Letter graded (A, A-, B+, etc.)

COM 585: Communicating Science and Health Risks to the Public
An exploration of risk communication theories and strategies, and their application to effective communication in science, environmental, and public health settings. The processes and effects of persuasive communication as they relate to message framing are also explored. Students will learn to use effective communication to advance individual and community-level decision-making about science and public health issues. Specifically, risk communication through interpersonal, organizational, and mediated channels will be explored, with particular attention paid to message features that are believed to generate predictable effects. Students will explore how communication impacts the public's experience of risk, and practice designing and delivering meaningful messages about potential science, health, and environmental hazards. This hands-on course provides opportunities to

practice designing and delivering a variety of risk messages.
3 credits, Letter graded (A, A-, B+, etc.)

COM 587: Independent Study
Intensive study of a special topic or intensive work on a reporting project undertaken with close faculty supervision. May be repeated. Prerequisites: Permission of instructor and graduate program director
3 credits, Letter graded (A, A-, B+, etc.)

COM 588: Graduate Internship
A practical, hands-on application of science communication skills in a real-world setting. Students participate in a semester-long internship with an organization or institution devoted to one or more of the programs themes of science, health, environment, and/or technology. The work must allow students to apply communication skills related to the educational goals of the program. Student interns will report regularly to a faculty member and will submit a portfolio of their work at the conclusion of the internship. 0-6 credits, S/U grading
May be repeated for credit.

COM 599: Project Work in Science Communication
A culminating experience for students in the Advanced Graduate Certificate in Science Communication. Students work individually or in groups to plan, design, and complete a capstone project rooted in science communication. Projects should allow students to apply what they have learned about science communication to a real-world context. Examples may include but are not limited to competing in science communication competitions, creating podcasts, writing book chapters, recording educational videos, designing a social media campaign, and/or creating newsworthy opportunities in the community. Students will submit a project proposal and participate in peer workshops to offer and receive feedback on their work throughout the semester. Students will formally present their work to peers, faculty, and members of the campus/community at the conclusion of the course. 3 credits, Letter graded (A, A-, B+, etc.)

COM 605: Environmental Communication
An overview of the empirical and theoretical foundations of environmental communication. This course will examine scholarship from the nascent days of the environmental movement to modern day research often focused on addressing the climate crisis. How experts, the public, and policy-makers interact with and perform environmental communication will be of considerable interest in this course. By analyzing broader public discourses about environmental topics such as environmental disasters and renewable energy, a deeper understanding of how our values and the environment are related will be reached. Students will also be expected to engage in environmental communication research during the course.
3 credits, Letter graded (A, A-, B+, etc.)

COM 699: Master's Project in Science Communication
A culminating experience for students in the MS in Science Communication. Students will identify and secure a faculty mentor under whom they will work independently to plan, design, and complete a research-based, science communication project. The project should reflect what students have cumulatively learned in the program and respond to the needs of an organization, community, or stakeholder group. Projects may take the form of original research intended for submission to an academic conference or translational research that informs the content development for a specific audience (e.g., educational module, communication campaign, social media strategy, etc.). Each project will have written, visual, and/or interactive components. Students will formally present their work to peers, faculty, and members of the campus/community at the conclusion of the course.
3 credits, Letter graded (A, A-, B+, etc.)

CONSTRM

Consortium Agreement

CONSTRM AGRMNT: Credit earned as transfer.
The procedure, which involves the completion of a Consortium Agreement, permits a student to attend another institution while receiving financial aid through Stony Brook. It is a process which is to be utilized only in extenuating situations. A student who feels that his/her situation can be documented and therefore warrants the use of this option should contact the Financial Aid Office.
0-12 credits,
May be repeated for credit.

CSE

Computer Science

CSE 502: Computer Architecture
Topics covered include instruction pipelines and memory caches to improve computer performance; instruction-level parallelism; machines: superscalar versus VLIW; cache and main memory hierarchy design tradeoffs; compiler optimizations to speed pipelines; low-power computer system design; processor, OS, and compiler support; graphics, DSP, and media processor design; disk I/O system design; interconnections and networking; and introduction to parallel architecture. Advanced topics include asynchronous microprocessors; FPGA-based reconfigurable computing; system on a chip; embedded processors; intelligent RAM and superconducting computers.

3 credits, Letter graded (A, A-, B+, etc.)

CSE 504: Compiler Design
This course covers advanced topics in compilation, including memory management, dataflow analysis, code optimization, just-in-time compilation, and selected topics from compilation of object-oriented and declarative languages.

3 credits, Letter graded (A, A-, B+, etc.)

CSE 505: Computing with Logic
The course explores logic-based computing and logic programming. It includes an introduction to programming in logic, covering basic techniques for solving problems in a logic programming system. Particular attention will be paid to user interface issues and how a logic system can provide a useful computing environment. The course covers implementation issues, emphasizing how a logic programming system generalizes both traditional programming language systems and traditional database systems.

3 credits, Letter graded (A, A-, B+, etc.)

CSE 506: Operating Systems
This course is an in-depth study of important concepts and techniques found in modern computer operating systems. The course focuses on an in-depth study of such important issues as virtual memory, resource management, locking and synchronization, file systems, networking, safety and security, and multiprocessor support, with an eye to recent directions in these areas. Textbook readings are supplemented where appropriate by papers from the research literature. An important part of the course is the case study of an actual modern operating system (e.g., Linux). Students study the source code for this operating system and do programming exercises and projects that involve modifying the operating system, testing their code's stability and functionality, and measuring its performance.

3 credits, Letter graded (A, A-, B+, etc.)

CSE 507: Introduction to Computational Linguistics
Overview of computational approaches to language use. Core topics include mathematical and logical foundations, syntax, semantics, and pragmatics. Special topics may include speech processing, dialog systems, machine translation, information extraction, and information retrieval. Statistical and traditional approaches are included. Students will develop familiarity with the literature and tools of the field.

3 credits, Letter graded (A, A-, B+, etc.)

CSE 508: Network Security

3 credits, Letter graded (A, A-, B+, etc.)

CSE 509: Computer System Security

3 credits, Letter graded (A, A-, B+, etc.)

CSE 510: Hybrid Systems
Hybrid Systems combine discrete state-machines and continuous differential equations and have been used as models of a large number of applications such as real-time software, embedded systems, robotics, mechatronics, aerospace systems, process control and biological systems. The course will cover modeling, design, analysis, and verification methods for hybrid systems. Topics may include SAT/SMT solvers, timed automata, formal logics for system specification, verification algorithms and closed-loop neural network control systems.

3 credits, Letter graded (A, A-, B+, etc.)

CSE 511: Brain and Memory Modeling
An introduction to brain modeling. Neuroscience topics include major brain structures, constituent glia and neurons, and synapses connecting neurons; how excited neurons send tonic firing spikes to other neurons; synapse changes during learning and forgetting; connection structures for stable ionic activity in neural networks; and distributed firing patterns underlying memory, perception, and thought. Computing topics include efficient methods for modeling electrical activity in single neurons using NEURON and in networks of millions of neurons using discrete event simulation. Participants will code simulations OR use neuroscience experience to refine brain models.

3 credits, Letter graded (A, A-, B+, etc.)

CSE 512: Machine Learning
A course on the fundamentals of machine learning, including basic models, formulations, and modern methods. Topics include PAC learnability, validation, classification, regression, clustering, component analysis, and graphical and deep learning models. Students are expected to have the following background: (i) working knowledge of probability theory and statistics, (ii) working knowledge of linear algebra and algorithms, and (iii) working knowledge of basic computer science principles at a level sufficient to write non-trivial computer programs in a language of preference.

3 credits, Letter graded (A, A-, B+, etc.)

CSE 514: Data Analytics Software Stacks and Algorithms
Architecture, and design of data analytics software stacks. We will cover MapReduce/ Hadoop/Dryad/Twister, Hadoop File System (HDFS), HBASE, NOSQL tools such as MongoDB, Cassandra, HIVE; column oriented database systems such as Vertica and MonetDB. We will also cover data analysis management systems that target the scientific domain such as ADIOS, sciDB; streaming systems such as IBM System S/ DataCutter. Systems, data structures and algorithms to support management and analysis of spatio-temporal data from video cameras, satellites, telescopes or beacons. We will study statistical methods, machine learning and image analysis/reconstruction methods used in big data/data analytic problems. Finally, we will survey big data/ data analytic problems from several domains including biomedical analysis of multi scale, multi-modal biomedical imaging data, next generation genetic and demonic data, analysis of electronic medical record/ population health data; internet, internet search, recommender systems; and engineering and physical science, analysis of experimental and simulation data associated with design of energetic materials, oil reservoir simulation, nuclear fusion and self-driving cars.

3 credits, Letter graded (A, A-, B+, etc.)

CSE 515: Introduction to Transaction Processing Systems
Discusses transaction processing systems. Topics covered include models of transactions,
including nested transactions and workflow; architectures of transaction processing systems, including client-server, two-tiered, and three-tiered architectures; concurrency controls for conventional and relational databases including two-phase locking and the SQL isolation levels; logging and recovery; distributed transactions including the two-phase commit protocol; replication; Internet commerce, including encryption, the SSL and SET protocols, goods atomicity, and electronic cash.

3 credits, Letter graded (A, A-, B+, etc.)

CSE 516: Science for Society I
This is part one of an interdisciplinary course sequence (1 credit each) is designed for students in computer science (CS) and students of technology and society (DTS). Students taking this course will enhance their abilities to critically think and build awareness for science and technology (ST) and their societal aspects. They will learn strategies for assessing important questions such as: what should I focus my efforts on, where are societal needs, what policies are required or can be taken advantage of, how can I possibly influence policy, and finally, what are the dangers when developing new ST. To teach these topics the course takes a practical approach. The first section of the sequence examines historical science and technology successes and failures. Then, in the second section, teams composed of students from both the CS and DTS departments conduct case studies of existing ST or design and implement new ST under the perspectives of the course. 1 credit, Letter graded (A, A-, B+, etc.)

CSE 517: Science for Society II
This is part two of an interdisciplinary course sequence (1 credit each) is designed for students in computer science (CS) and students of technology and society (DTS). Students taking this course will enhance their abilities to critically think and build awareness for science and technology (ST) and their societal aspects. They will learn strategies for assessing important questions such as: what should I focus my efforts on, where are societal needs, what policies are required or can be taken advantage of, how can I possibly influence policy, and finally, what are the dangers when developing new ST. To teach these topics the course takes a practical approach. The first section of the sequence examines historical science and technology successes and failures. Then, in the second section, teams composed of students from both the CS and DTS departments conduct case studies of existing ST or design and implement new ST under the perspectives of the course. 1 credit, Letter graded (A, A-, B+, etc.)

CSE 518: Foundations of Human Computer Interactions
The focus of this course is on the design, evaluation, and implementation of interactive computing systems for human use and on the study of major phenomena surrounding them. This course will provide the students with a strong grounding in the guidelines, principles, methodologies, tools, and techniques for analyzing, designing, and evaluating user interfaces and interaction techniques. Topics include: 1) Human Information Processing System 2) Interaction Behavior Modeling 3) Computational Interface Design 4) User Centered Design 5) Sketching and Prototyping 6) Usability Testing 7) Heuristic Evaluation 8) Natural User Interfaces & the Future of Uls 9) State-of-the-art research within HCI 3 credits, Letter graded (A, A-, B+, etc.)

CSE 519: Data Science Fundamentals
This course will cover the building blocks of data science from managing the data itself to algorithmic and analytical techniques. Specific topics include data preparation, exploratory data analysis, statistics, visualization, optimization, unstructured data, distributed analyses. 3 credits, Letter graded (A, A-, B+, etc.)

CSE 521: Data Mining Concepts and Techniques
Data Mining is a new, promising and flourishing interdisciplinary field drawing work from areas including database technology, artificial intelligence, machine learning, pattern recognition, high-performance computing, and data visualization. It focuses on issues relating to the feasibility, usefulness, efficiency, and scalability of techniques for automated extraction of patterns representing knowledge implicitly stored in large databases, warehouses, and other massive information repositories. The course gives a broad, yet in-depth overview of the field of data mining and presents one or two techniques in rigorous detail. 3 credits, Letter graded (A, A-, B+, etc.) May be repeated for credit.

CSE 522: Special Project in Computer Science
Project in a sub-discipline of Computer Science, including but not limited to, computer architecture, operating systems, programming languages, compilers, artificial intelligence, networking, computer graphics, data mining, databases, computer vision, visualization, computer security, mobile computing, parallel processing, logic programming, hybrid systems, simulation and modeling, computational biology, and multimedia. 3 credits, Letter graded (A, A-, B+, etc.) May be repeated for credit.

CSE 523: Advanced Project in Computer Science I
First part of an advanced project in computer science that will extend over two semesters. The student starts the project in one semester by registering for CSE523 and completes the project in a following semester by registering for CSE524. CSE523/524 sequence must be on the same project under the direction of the same advisor. The student must identify a faculty advisor before registering. 3 credits, Letter graded (A, A-, B+, etc.) May be repeated for credit.

CSE 524: Advanced Project in Computer Science II
Part 2 of a 2-semester advanced research and development project undertaken by MS students under the supervision of a CS graduate program faculty member. The student starts the project in one semester by registering for CSE 523 and completes the project in a subsequent semester by registering for CSE 524 under the supervision of the same faculty member. 3 credits, Letter graded (A, A-, B+, etc.) May be repeated for credit.

CSE 525: Introduction to Robotics
This course introduces the fundamental concepts in robotics, including coordinate transformations, visual perception, sensors, path planning, kinematics, feedback control, and feedforward control. These topics will be exemplified with several state-of-the-art robotics platforms. The course will also focus on applying the fundamental concepts to the key approaches to mobile robot control (reactive, behavior-based, and hybrid), and briefly discuss robot learning and multi-robot systems. 3 credits, Letter graded (A, A-, B+, etc.)

CSE 526: Principles of Programming Languages
Discusses programming language concepts and design, with emphasis on abstraction mechanisms. Topics include language paradigms (procedural, object-oriented, functional, and logic), language concepts (values, bindings, types, modules), and foundations (lambda calculus, denotational semantics). Examples will be drawn from several representative languages, such as C, Java, Standard ML, and Prolog.
CSE 527: Introduction to Computer Vision
Introduction to basic concepts in computer vision. Low-level image analysis, image formation, edge detection, segmentation. Image transformations for image synthesis methods for 3D scene reconstruction, motion analysis, object recognition.
3 credits, Letter graded (A, A-, B+, etc.)

CSE 528: Computer Graphics
This course emphasizes a hands-on approach to the use of computer graphics. The topics covered include models, picture description, and interaction; c windowing, clipping, panning, and zooming; geometrical transformations in 2D and 3D; algorithms for raster displays (scan-line conversion, polygon fill, polygon clipping, etc.); hidden line and hidden surface removal, shading models; user interaction. The students will implement a substantial graphics application program.
3 credits, Letter graded (A, A-, B+, etc.)

CSE 529: Simulation and Modeling
A comprehensive course in formulation, implementation, and application of simulation models. Topics include data structures, simulation languages, statistical analysis, pseudo-random number generation, and design of simulation experiments. Students apply simulation modeling methods to problems of their own design. This course is offered as CSE 529, AMS 553 and MBA 553.
3 credits, Letter graded (A, A-, B+, etc.)

CSE 530: Geometric Foundations of Graphics and Visualization
This course will focus on mathematical tools, geometric modeling techniques, and fundamental algorithms that are relevant to graphics, visualization, and other visual computing areas. The goal is to provide graduate students with a comprehensive knowledge of geometric concepts and demonstrate the significance of these mathematical tools and geometric algorithms in graphics and relevant areas. Course topics include geometric algorithms for both polygonal and curved objects, theory of parametric and implicit representations, modeling methods of curves, surfaces, and solids, in-depth spline theory, rudiments of wavelet theory and multi-resolution shape representations, differential geometry fundamentals, and other sophisticated topics and latest advances in the field.
3 credits, Letter graded (A, A-, B+, etc.)

CSE 531: Performance Analysis of Systems
This is a new course that covers topics in the performance analysis of computer systems. The contents of the course should prove very helpful for computer science students who wish to analyze computer systems and learn more about how to improve the performance of systems. Existing courses do not cover this material. The course is targeted primarily at PhD and Masters students in the Computer Science Department, however upper-level undergraduates can take the course as well. In addition, students from AMS, Math and ECE would also benefit from the course contents.
3 credits, Letter graded (A, A-, B+, etc.)

CSE 532: Theory of Database Systems
The course will cover advanced topics in modern database systems, including object-oriented databases, rule-based databases, temporal and active databases, parallel and distributed databases, distributed object model, data mining, online analytical processing, data warehousing, multimedia databases.
3 credits, Letter graded (A, A-, B+, etc.)

CSE 533: Network Programming
Topics include Unix and Linux socket API programming at the TCP, UDP, IP (raw sockets) and datalink access (Linux PF_PACKET sockets, libpcap & libnet libraries) levels, in the context of developing and implementing client-server applications, reliable data transfer using TCP-like rdt and flow control mechanisms, routing protocols, address resolution protocols, multicasting, DNS protocols.
3 credits, Letter graded (A, A-, B+, etc.)

CSE 534: Fundamentals of Computer Networks
3 credits, Letter graded (A, A-, B+, etc.)

CSE 535: Distributed Systems
Discusses asynchronous systems, their description using concurrent and distributed programming languages, and their verification. Topics include concurrent programming using shared memory and message passing, formal semantics of communication, reliability, and concurrent algorithms.
3 credits, Letter graded (A, A-, B+, etc.)

CSE 536: Introduction to User-Interface Development
Survey of user-interface systems, includes command language, windowing, multiple input/output devices, architecture of user interface management systems, toolkits for designing user-interface, human factors, standards, visual languages. The course also includes discussion of emerging technologies, such as systems for cooperative work, physically distributed user-interfaces, parallelism and user-interfaces, virtual reality. A substantial project requiring the design, implementation, and evaluation of a user-interface will be required
3 credits, Letter graded (A, A-, B+, etc.)

CSE 537: Artificial Intelligence
A comprehensive introduction to the problems of artificial intelligence and techniques for attacking them. Topics include problem representation, problem-solving methods, search, pattern recognition, natural language processing, learning, expert systems, and AI programming languages and techniques. Covers both theoretical methods and practical implementations.
3 credits, Letter graded (A, A-, B+, etc.)

CSE 538: Natural Language Processing
The course offers an introduction to Natural Language Processing techniques and applications. The course introduces basic deep learning techniques for constructing representations of natural language texts, syntactic analyses, and canonical applications such as Question Answering, and Machine Translation. The emphasis is on understanding how (i) the basic requirements of language analyses and specific application needs can be formulated as learning problems, (ii) how aspects of natural language, such as syntactic and semantic structure, inspire the design of and are captured by modern state of the art techniques, and (iii) how to evaluate and understand the limitations and shortcomings of the models
3 credits, Letter graded (A, A-, B+, etc.)

CSE 540: Theory of Computation
Topics include models of computation: finite-state machines, stack machines, Turing machines, Church's thesis; computability theory: halting problem and unsolvability, introductory recursion theory; complexity theory: complexity measures, time and space hierarchy, NP-complete problems.
3 credits, Letter graded (A, A-, B+, etc.)
CSE 541: Logic in Computer Science
A survey of the logical foundations of mathematics and the relationships to computer science; development of propositional calculus and quantification theory; the notions of a proof and of a model; the completeness theorem.
3 credits, Letter graded (A, A-, B+, etc.)

CSE 542: Big Data Systems, Algorithms and Networks
Recent progress on big data systems, algorithms and networks. Topics include the web graph, search engines, targeted advertisements, online algorithms and competitive analysis, and analytics, storage, resource allocation, and security in big data systems. Offered in the Spring Semester
3 credits, Letter graded (A, A-, B+, etc.)

CSE 544: Probability and Statistics for Data Scientists
The course will cover core concepts of probability theory and an assortment of standard statistical techniques. Specific topics will include random variables and distributions, quantitative research methods (correlation and regression), and modern techniques of optimization and matching learning (clustering and prediction).
3 credits, Letter graded (A, A-, B+, etc.)

CSE 545: Big Data Analytics
The course will cover concepts and standard tools used to analyze, so called, Big Data. Specifically, it will cover algorithmic approaches to analyzing large datasets: MapReduce, graph analytics, text analytics, streaming algorithms, as well as modern distribution analysis platforms (e.g. Hadoop, Spark).
3 credits, Letter graded (A, A-, B+, etc.)

CSE 546: Cryptography
Cryptography studies how to perform computational tasks securely in adversarial environments. It plays an important role in designing secure systems. This is an introductory course that covers basic concepts and proof techniques in this area, as well as some recent research trends. The course is theoretical in nature, with emphasis on proofs and algorithmic reductions, even when discussing applied topics. No prior background in cryptography is assumed. However, students should have mathematical maturity and be comfortable with definitions and proofs.
3 credits, Letter graded (A, A-, B+, etc.)

CSE 547: Discrete Mathematics
This course introduces such mathematical tools as summations, number theory, binomial coefficients, generating functions, recurrence relations, discrete probability, asymptotics, combinatorics, and graph theory for use in algorithmic and combinatorial analysis. This course is offered as both CSE 547 and AMS 547.
3 credits, Letter graded (A, A-, B+, etc.)

CSE 548: Analysis of Algorithms
Techniques for designing efficient algorithms, including choice of data structures, recursion, branch and bound, divide and conquer, and dynamic programming. Complexity analysis of searching, sorting, matrix multiplication, and graph algorithms. Standard NP-complete problems and polynomial transformation techniques. This course is offered as both AMS 542 and CSE 548.
3 credits, Letter graded (A, A-, B+, etc.)

CSE 549: Computational Biology
This course focuses on current problems in computational biology and bioinformatics. Our emphasis will be algorithmic, on discovering appropriate combinatorial algorithm problems and the techniques to solve them. Primary topics will include DNA sequence assembly, DNA/protein sequence comparison, hybridization array analysis, RNA and protein folding, and phylogenetic trees.
3 credits, Letter graded (A, A-, B+, etc.)

CSE 550: Quantum Computing and Information Technology
The course emphasizes a hands-on approach to scientific, medical, and information visualization and visual analytics. Topics include: traditional visualization techniques, the visualization process, visual perception and cognition, basic graphics and imaging concepts, visualization of sampled, observed, and computed data, volume and flow visualization, information visualization, human-computer interaction, and the coupling of intelligent computing with visualization.
3 credits, Letter graded (A, A-, B+, etc.)

CSE 555: Computational Geometry
Study of the fundamental algorithmic problems associated with geometric computations, including convex hulls, Voronoi diagrams, triangulation, intersection, range queries, visibility, arrangements, and motion planning for robotics. Algorithmic methods include plane sweep, incremental insertion, randomization, divide-and-conquer, etc. This course is offered as both AMS 545 and CSE 555.
3 credits, Letter graded (A, A-, B+, etc.)

CSE 556: Visualization
Virtual Reality (VR) is a fast-moving technology and has the potential to revolutionize our lives. VR stimulates the user’s senses, thereby believing in an artificial version of reality. The course will cover VR fundamentals and technologies and related topics, including an introduction to VR, VR systems, geometry and transformations in VR, viewing and projections, light, optics, and human vision physiology, temporal human vision and perception, motion, vector, and tracking, 3D user interfaces (selection, manipulation, and travel), augmented reality (AR), audio in VR, and non-visual senses. 3 credits, Letter graded (A, A-, B+, etc.)

CSE 570: Wireless and Mobile Networks


CSE 577: Medical Imaging

This course presents an introduction to the mathematical, physical, and computational principles underlying modern medical imaging systems. It covers fundamentals of X-ray radiography, X-ray computed tomography (CT), ultrasonic imaging, nuclear imaging, magnetic resonance imaging (MRI), and functional MRI (fMRI), and as well as more general concepts required for these, such as linear systems theory, the Fourier Transform, and numerical optimization. Popular techniques for the visualization, segmentation, and analysis of medical image data will also be discussed, as well as applications of medical imaging, such as image-guided intervention. 3 credits, Letter graded (A, A-, B+, etc.)

CSE 581: Computer Science Fundamentals: Theory

The course consists of two parts. The first part covers discrete mathematics – a division of mathematics that is extensively used in computer science. The topics covered include: logic (propositional logic and predicate logic), proof techniques, sequences (mathematical induction and recursion), and functions. The second part covers the theory of computation -- a division of theoretical computer science that deals with what can be computed and what cannot be computed on a computer. The topics covered include: computational models (FA, PDA, and Turing machines), grammars accepted by different computational models (regular grammars, context-free grammars, and unrestricted grammars), languages accepted by different computational models (regular languages, context-free language, and Turing-acceptable languages), Turing-complete systems, and algorithmically unsolvable problems. 3 credits, Letter graded (A, A-, B+, etc.)

CSE 582: Computer Science Fundamentals: Data Structures and Algorithms

The course consists of two parts. The first part covers data structures to efficiently store, organize, modify, and access data. Topics include: arrays, stacks, queues, linked lists, trees, sets, hash maps, priority queues, and graphs. The second part covers the design and analysis of algorithms for solving computer science problems. Topics include: algorithm analysis, exhaustive search algorithms, divide-and-conquer algorithms, greedy algorithms, and dynamic programming algorithms. 3 credits, Letter graded (A, A-, B+, etc.)


Programming concepts and paradigms, including functional programming, object-orientation, basics of type systems, program and data abstractions, parameter passing, and modularity. 3 credits, Letter graded (A, A-, B+, etc.) May be repeated for credit.

CSE 587: Proficiency Requirement

This course is used by students to fill any gaps in key CS proficiency background) areas identified at the time of admission. This course is done under the supervision of a faculty member teaching an undergraduate course in the needed proficiency area. By permission of the Graduate Program only. 3 credits, Letter graded (A, A-, B+, etc.) May be repeated for credit.

CSE 589: Topics in Computer Science

An advanced lecture course on a new topic in computer science. The course is primarily designed for M.S. students, but can be taken by Ph.D. students as well. Semester supplements to this Bulletin contain specific description when course is offered. May be repeated as the topic changes, but cannot be used more than twice to satisfy CSE major requirements for M.S. Limited to CSE graduate students; others, permission of instructor. Spring, 3 credits, Letter graded (A, A-, B+, etc.) May be repeated for credit.

CSE 591: Topics in Computer Science

An advanced lecture course on a new topic in computer science. The course is primarily designed for M.S. students, but can be taken by Ph.D. students as well. Semester supplements to this Bulletin contain specific description when course is offered. May be repeated for credit as the topic changes, but cannot be used more than twice to satisfy CSE major requirements for M.S. Limited to CSE graduate students; others, permission of instructor. Spring, 3 credits, Letter graded (A, A-, B+, etc.) May be repeated for credit.

CSE 592: Advanced Topics in Computer Science

An advanced lecture course on a new topic in computer science. The course is primarily designed for M.S. students, but can be taken by Ph.D. students as well. Semester supplements to this Bulletin contain specific description when course is offered. May be repeated for credit as the topic changes, but cannot be used more than twice to satisfy CSE major requirements for M.S. Limited to CSE graduate students; others, permission of instructor. Spring, 3 credits, Letter graded (A, A-, B+, etc.) May be repeated for credit.

CSE 593: Independent Study in Computer Science

Research and/or project work under the supervision of a Computer Science graduate student. 1-9 credits, Letter graded (A, A-, B+, etc.) May be repeated for credit.

CSE 594: Advanced Topics in Computer Science

An advanced lecture course on a new topic in computer science. The course is primarily designed for M.S. students, but can be taken by Ph.D. students as well. Semester supplements to this Bulletin contain specific description when course is offered. May be repeated as the topic changes, but cannot be used more than twice to satisfy CSE major requirements for M.S. Limited to CSE graduate students; others, permission of instructor. Fall, Spring, every year, 3 credits, Letter graded (A, A-, B+, etc.) May be repeated for credit.
CSE 595: Advanced Topics in Computer Science

An advanced lecture course on a new topic in computer science. This course is primarily designed for M.S. students, but can be taken by Ph.D. students as well. Semester supplements to this Bulletin contain specific description when course is offered. May be repeated for credit as the topic changes, but cannot be used more than twice to satisfy the SCE major requirements for the M.S.

Fall, Spring, every year, 3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

CSE 596: MS Internship Project Off-Campus

Participation in internships at private corporations, public agencies, or non-profit institutions. Students will be required to have a faculty coordinator as well as a contact in the outside organization to participate with them in regular consultations on the project, and to submit a final report to both. This course is intended for MS students interning off campus.

1 credit, S/U grading
May be repeated for credit.

CSE 597: MS Internship Project on Campus

Participation in internships at private corporations, public agencies, or non-profit institutions. Students will be required to have a faculty coordinator as well as a contact in the outside organization to participate with them in regular consultations on the project, and to submit a final report to both. This course is intended for MS students interning on campus.

1 credit, S/U grading
May be repeated for credit.

CSE 599: M.S. Thesis Research

Thesis research under supervision of CS graduate program faculty for MS students. 1-12 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

CSE 600: Research in Modern Computer Science

A survey of current computer science research areas and issues. This course comprises lectures by faculty members and visitors, selected readings, and introductory-level research problems. Prerequisite: Permission of instructor

0-1 credits, S/U grading
May be repeated for credit.

CSE 602: Advanced Computer Architecture

The focus will be on the architectural rather than micro-architectural issues, and a systems approach to computer architecture taking into account the interaction between the architecture and the compiler, operating system, database, and networking. The course starts with superscalar/VLIW processor architecture and proceeds to memory hierarchy, storage systems, network hardware, graphics processor, and database machines. The emphasis will be on hands-on evaluation of architectural ideas, the exploration of software/hardware design trade-offs, and the articulation of experimental procedures and performance analysis. A publication-quality class project will be required.

3 credits, Letter graded (A, A-, B+, etc.)

CSE 605: Performance Evaluation of Computer Systems

The purpose of this course is to provide background and training in understanding and evaluating the performance of computer systems, including centralized, distributed, parallel, client/server-based systems, and computer communication networks. The goal is to develop a perspective on how the performance of computer systems or networks should be evaluated in order to decide on various design alternatives. The course will include various analytical techniques, mainly based on Markov models and queuing theory, and simulation modeling.

3 credits, Letter graded (A, A-, B+, etc.)

CSE 608: Advanced Computer Security

Advanced course on principles and practice of engineering secure information systems. Topics covered include threats and vulnerabilities, counter measures, legal policy issues, risk management and assurance. In-depth coverage of various research problems, which will vary from one offering of the course to another.

Prerequisite: CSE 508 or CSE 509 or permission of instructor.
Fall, 3 credits, Letter graded (A, A-, B+, etc.)

CSE 610: Parallel Computer Architectures

Topics include parallel computer systems; important parallel applications; parallel compilation models; interconnection networks; SIMD and MIMD architectures; hybrid architectures; memory management; cache coherence; distributed shared memory; synchronization methods; operating systems; compilers; and programming tools.

3 credits, Letter graded (A, A-, B+, etc.)

CSE 613: Parallel Programming

Algorithms and techniques for programming highly parallel computers. Trends in parallel and distributed computing; shared address space and message passing architectures; design issues for parallel algorithms; converting sequential algorithms into equivalent parallel algorithms; synchronization and data sharing; improving performance of parallel algorithms; interconnection network topologies, routing, and flow control; latency limits on speedup of algorithms by parallel implementations.

3 credits, Letter graded (A, A-, B+, etc.)

CSE 614: Advanced Programming Languages

Selected topics on advanced programming languages technology. Program analysis and transformation, program optimization and program manipulation systems. Very high-level and declarative languages such as sets and relations based languages and deductive and object-oriented languages.

Prerequisite: CSE 526 or CSE 504
Spring, 3 credits, Letter graded (A, A-, B+, etc.)

CSE 615: Advanced Computer Vision

Survey of methods used for the analysis of images by computer, including computer vision and pattern recognition. Topics to be covered are image formation, image segmentation, and edge detection, binary images, and shape analysis, shape from shading, motion field, and optical flow, surface inference, classification techniques.

3 credits, Letter graded (A, A-, B+, etc.)

CSE 617: Advanced Topics in Wireless Networks

Advance topics taken from ad hoc wireless networks and sensor networks. Will comprise of lectures, presentations and/or a project.

Prerequisite: Limited to CSE graduate students; others, permission of instruction.
Fall and Spring, 3 credits, Letter graded (A, A-, B+, etc.)
May be repeated 2 times FOR credit.

CSE 620: Virtual Reality

Practical issues in the design and implementation of virtual environments. Topics include system requirements, transformations, user-interaction models, human vision models, input/output devices and techniques, tracking systems, augmented reality, and virtual-reality applications. The course will involve a substantial programming project to implement an immersive virtual reality system.

3 credits, Letter graded (A, A-, B+, etc.)
CSE 621: Physics-based Modeling for Visual Computing
A unified approach to various fields such as graphics, visualization, computer-aided geometric design, biomedical imaging, vision, and virtual environment. The course will explore select research topics centered on physics-based modeling methodology and associated computational methods for theoretical and practical problems in widespread areas of visual computing. The emphasis will be on geometric and solid modeling, geometric design techniques, wavelets and multi-resolution analysis, deformable models based on mathematical physics, variational analysis, optimization methods, numerical simulation with finite-difference and finite-element algorithms, differential equations for initial-value and boundary-value problems, force-driven interaction with constraints, dynamic sculpting system, and a large variety of applications for visual computing.
3 credits, Letter graded (A, A-, B+, etc.)

CSE 624: Advanced Operating Systems
Students will study advanced operating system topics and be exposed to recent developments in operating systems research. In addition to being conversant in classic and recent research papers, this course aims to teach students to read research papers critically, formulate new research questions, and evaluate these questions experimentally. Topics to be covered typically include: distributed systems, cloud computing and data centers, operating system design, virtual machines, OS interaction with the hardware architecture, synchronization and communication, file systems, and security.
3 credits, Letter graded (A, A-, B+, etc.)

CSE 625: Advanced Asynchronous Systems
Formal specification and verification of asynchronous systems. Topics include concurrent programming, process algebras, logics for describing the properties of concurrent systems, and formal semantics of communication.
3 credits, Letter graded (A, A-, B+, etc.)

CSE 626: Switching and Routing in Parallel and Distributed Systems
This course covers various switching and routing issues in parallel and distributed systems. Topics include message switching techniques, design of interconnection networks, permutation, multicast and all-to-all routing in various networking nonblocking, and rearrangeable capability analysis and performance modeling.
3 credits, Letter graded (A, A-, B+, etc.)

CSE 628: Natural Language Processing
The course offers computationally-oriented introduction to natural language processing (NLP). The focus is on modern quantitative techniques in NLP: algorithms and statistical approaches to word-level, syntactic, and semantic processing of natural language. The choice of topics includes practically motivated questions in NLP such as (1) can we teach computers to automatically detect authorship of a document? (2) can computers automatically suggest paraphrases (phrases with similar meaning) to help with writing? Prerequisite: Familiarity with either Artificial Intelligence or Machine Learning is strongly recommended, but not absolutely required. Limited to CSE Graduate Students Fall and Spring. 3 credits, Letter graded (A, A-, B+, etc.)

CSE 633: Computability and Undecidability
Computability theory based on Turing machines and recursive functions; proof by diagonalization and reducibility; unsolvable problems in set, group, number and language theory; reducibility orderings and degrees of unsolvability; priority methods and Post's problem. Prerequisite: CSE 540 or consent of instructor.
3 credits, Letter graded (A, A-, B+, etc.)

CSE 638: Advanced Algorithms
This is an advanced course in the design and analysis of combinatorial algorithms, focusing on recent material and special topics, including randomized algorithms, approximation algorithms for NP-complete problems, string algorithms, amortized analysis of data structures, and heuristic methods such as simulated annealing. Material will be selected to have little or no overlap with traditional introductory algorithms courses.
3 credits, Letter graded (A, A-, B+, etc.)

CSE 639: Seminar in Advanced Topics in Computer Science
May be repeated for credit.

CSE 641: Seminar in Logic in Computer Science

CSE 642: Seminar in Algorithms
May be repeated for credit.

CSE 643: Seminar in Concurrency
May be repeated for credit.

CSE 644: Seminar in Databases
May be repeated for credit.

CSE 645: Seminar in Languages
May be repeated for credit.

CSE 646: Seminar in Artificial Intelligence

CSE 648: Seminar in Graphics
May be repeated for credit.

CSE 649: Seminar in Operating Systems
May be repeated for credit.

CSE 650: Seminar in Architecture
May be repeated for credit.

CSE 651: Seminar in Secure Computation
May be repeated for credit.

CSE 652: Seminar in User Interfaces
May be repeated for credit.

CSE 653: Seminar in Virtual Reality
May be repeated for credit.

CSE 654: Seminar in Visualization
May be repeated for credit.

CSE 655: Seminar in Natural Language Processing
May be repeated for credit.

CSE 656: Seminar in Computer Vision
Current readings in computer vision and image understanding.
Prerequisite: Limited to CSE graduate students; others need instructor consent Fall, 1 credit, S/U grading May be repeated for credit.

CSE 657: Seminar in Design Analysis
Methods for constructing reliable and efficient computer systems. Topics include: modeling and specification, analysis and verification, design and optimization, code generation, simulation and testing. Tool support. Applications and case studies.
Prerequisite: Limited to CSE graduate students; others need instructor consent Fall, 1 credit, S/U grading May be repeated for credit.
CSE 658: Seminar on Mobile and Wireless Networking
This seminar course will draw topics from mobile and wireless networks of current interest. The main focus will be multi-hop wireless networks. It will cover topics on mobile routing, multiple access and transport protocols for such networks. It will also cover topics from micromobility architectures and pervasive computing.
Prerequisites: Limited to CSE graduate students; others permission of instructor.
Fall, 1 credit, S/U grading
May be repeated for credit.

CSE 659: Seminar in Computer Security
Seminar course, covering various research problems in computer security.
Spring, 1 credit, S/U grading
May be repeated for credit.

CSE 660: Seminar in Media Networks
Graduate seminar that covers recent work on multimedia and networks.
Fall, 1 credit, S/U grading
May be repeated for credit.

CSE 660: Seminar in Sustainable Computing
Seminar course which focuses on research in sustainable computing.
1 credit, S/U grading
May be repeated for credit.

CSE 661: Seminar in Data Privacy
Current research in Data Privacy.
Limited to CSE graduate students; others permission of instructor.
Spring, 1 credit, S/U grading
May be repeated for credit.

CSE 662: Seminar in Medical Imaging
May be repeated for credit.

CSE 663: Cyber Physical Systems and Verification
Seminar course which focuses on research in Cyber-Physical Systems and Verification.
1 credit,
May be repeated for credit.

CSE 664: Distributed Systems
Seminar course which focuses on research in Distributed Systems.
1 credit,
May be repeated for credit.

CSE 665: Special Topics in Theory of Computing
May be repeated for credit.

CSE 666: Special Topics in Databases
May be repeated for credit.

CSE 667: Special Topics in Image Processing
May be repeated for credit.

CSE 668: Special Topics in Computer Vision
Advanced research topics course.
Prerequisite: Limited to CSE graduate students; others need instructor consent
Fall, 2 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

CSE 669: Special Topics in Databases
May be repeated for credit.

CSE 670: Special Topics in Languages
May be repeated for credit.

CSE 671: Special Topics in Artificial Intelligence
May be repeated for credit.

CSE 672: Special Topics in Operating Systems
May be repeated for credit.

CSE 673: Special Topics in Operating Systems
May be repeated for credit.

CSE 674: Special Topics in User Interfaces
May be repeated for credit.

CSE 675: Special Topics in Artificial Intelligence
May be repeated for credit.

CSE 676: Special Topics in Computer Science
May be repeated for credit.

CSE 677: Special Topics in User Interfaces
May be repeated for credit.

CSE 678: Special Topics in Computer Science
May be repeated for credit.

CSE 679: Special Topics in Computer Science
May be repeated for credit.

CSE 680: Special Topics in Computer Science
May be repeated for credit.

CSE 681: Special Topics in Computer Vision
Advanced research topics course.
Prerequisite: Limited to CSE graduate students; others need instructor consent
Fall, 2 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

CSE 682: Special Topics in Computer Science
May be repeated for credit.

CSE 683: Special Topics in Computer Science
May be repeated for credit.

CSE 684: Special Topics in Computer Security
Special topics course, covering selected research areas in computer security.
Spring, 2 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

CSE 685: Special Topics in Computer Science
May be repeated for credit.

CSE 686: Special Topics in Computer Security
May be repeated for credit.

CSE 687: Special Topics in Applied Cryptography
May be repeated for credit.

CSE 688: Special Topics in Computer Science
May be repeated for credit.

CSE 689: Special Topics in Computer Science
May be repeated for credit.

CSE 690: Advanced Topics in Computer Science
An advanced lecture course on a new topic in computer science. This course is primarily designed for PhD students, but can be taken by M.S. students as well. Semester supplements to this Bulletin contain specific description when course is offered. May be repeated for credit as the topic changes, but cannot be used more than twice to satisfy CSE major requirements for M.S. Limited to CSE graduate students; others permission of instructor.
Spring, 3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

CSE 691: Advanced Topics in Computer Science
An advanced course on a new topic in computer science. This course is primarily designed for Ph.D. students, but can be taken by M.S. students as well. Semester supplements to this Bulletin contain specific description when course is offered. May be repeated for credit as the topic changes, but cannot be used more than twice to satisfy CSE major requirements for M.S. Limited to CSE graduate students; others permission of instructor.
Spring, 3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

CSE 692: Advanced Topics in Computer Science
An advanced lecture course on a new topic in computer science. This course is primarily designed for Ph.D. students, but can be taken by M.S. students as well. Semester supplements to this Bulletin contain specific description when course is offered. May be repeated for credit as the topic changes, but cannot be used more than twice to satisfy CSE major requirements for M.S. Limited to CSE graduate students; others permission of instructor.
Spring, 3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

CSE 693: Advanced Topics in Computer Science
An advanced lecture course on a new topic in computer science. This course is primarily designed for Ph.D. students, but can be taken by M.S. students as well. Semester supplements to this Bulletin contain specific description when course is offered. May be repeated for credit as the topic changes, but cannot be used more than twice to satisfy CSE major requirements for M.S. Limited to CSE graduate students; others permission of instructor.
Spring, 3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.
Sustainability is a societal problem that affects us all. With the recent emphasis on the adverse impact of carbon emissions from data centers, there is renewed interest from industry, government, and academia in making computing more sustainable. This seminar course will cover recent advances in this space. Specifically, we will first discuss the nature of the problem and the cost of unsustainable data center operations, especially for AI workloads. We will then discuss factors that contribute to unsustainable operations in data centers and computing broadly, including operational and embedded carbon. The remaining of the course will focus on defining the problem, the metrics of sustainability in computing, and possible approaches to stem unsustainable computing in data centers, including space- and time-scheduling of workloads to better leverage clean energy, lowering the compute demand of workloads, and harnessing latest hardware advances to reduce embodied carbon in computing. This 1-credit seminar course will cover topics in computation sustainability, including (but not limited to): - definition of computational sustainability, including components and metrics of sustainability used in research and practice - current state of computational sustainability in data centers and for specific workloads, such as AI and ML training - unsustainable practices in data centers and computing and reasons behind them - survey of proposed solutions in literature and discussion Students enrolling for the seminar will be expected to lead at least 2 weekly meetings by summarizing recent papers on computational sustainability, and to participate in all meeting discussions.

1 credit, S/U grading

CSE 695: Seminar in Deep Learning Theory
This course will cover some recent optimization theory as it relates to training deep neural networks, covering topics including: - landscape analysis of overparameterized nonconvex networks - implicit bias of gradient descent - tools for computing generalization bounds - the neural tangent kernel as an analysis tool Students enrolling for the course will be expected to watch a handful of online lectures, lead at least 1 weekly meeting which either summarizes a paper or an online lecture, and participate in all meeting discussions.

1 credit, S/U grading

CSE 696: PhD Internship Project Off-Campus
Participation in internships at private corporations, public agencies, or non-profit institutions. Students will be required to have a faculty coordinator as well as a contact in the outside organization to participate with them in regular consultations on the project, and to submit a final report to both. This course is intended for PhD students interning off campus.

1-3 credits, S/U grading
May be repeated for credit.

CSE 697: PhD Internship Project On-Campus
Participation in internships at private corporations, public agencies, or non-profit institutions. Students will be required to have a faculty coordinator as well as a contact in the outside organization to participate with them in regular consultations on the project, and to submit a final report to both. This course is intended for PhD students interning on campus.

1 credit, S/U grading
May be repeated for credit.

CSE 698: Practicum in Teaching
Supervised teaching in a course identified by the student and the Graduate Program Director.

0-3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

CSE 699: Dissertation Research on Campus
Thesis research for PhD students who have advanced to candidacy (G5 status). This course is taken by students when a majority portion of the research is done on campus, at Cold Spring Harbor, or at the Brookhaven National Lab.

0-9 credits, S/U grading
May be repeated for credit.

CSE 700: Dissertation Research off Campus - Domestic
Prerequisite: Must be advanced to candidacy (G5). Major portion of research will take place off-campus, but in the United States and/or U.S. provinces. Please note, Brookhaven National Labs and the Cold Spring Harbor Lab are considered on-campus. All international students must enroll in one of the graduate student insurance plans and should be advised by an International Advisor.

Fall, Spring, 0-9 credits, S/U grading
May be repeated for credit.

CSE 701: Dissertation Research off Campus - International
Prerequisite: Must be advanced to candidacy (G5). Major portion of research will take place outside of the United States and/or U.S. provinces. Domestic students have the option of the health plan and may also enroll in MEDEX. International students who are in their home country are not covered by mandatory health plan and must contact the Insurance Office for the insurance charge to be removed. International students who are not in their home country are charged for the mandatory health insurance. If they are to be covered by another insurance plan they must file a waiver be second week of classes. The charge will only be removed if other plan is deemed comparable.

All international students must received clearance from an International Advisor.

Fall, Spring, 0-9 credits, S/U grading
May be repeated for credit.

CSE 800: FT SUMMER RESEARCH
May be repeated for credit.

CSM

Center for Science and Mathematics Education

CSM 510: Biology Education Research: Teaching, Learning, and Assessment
Introduction to core policy documents, standards, concepts, and empirical methods in biology education research and their applications to undergraduate classroom settings. Appropriate for graduate students in the biological sciences and/or those enrolled in the Ph.D. Program in Science Education.

3 credits, Letter graded (A, A-, B+, etc.)

CSM 545: The Nature of Science
The nature of science refers to the values and assumptions inherent in the development, understanding and interpretation of scientific knowledge. Scientific knowledge is empirically based, culturally embedded, tentative, and incorporates subjectivity and creativity. This course will address the following: What is science? What distinguishes science from other ways of knowing or as being basic science, applied science or technology? What philosophical, social, ethical and historical perspectives are important in understanding the nature of science?

3 credits, Letter graded (A, A-, B+, etc.)

CSM 546: Topics Biotechnology
An introduction to the field of biotechnology. The course will survey the history of the development of genetic engineering, methodologies used in biotechnology, applications of biotechnology in medicine, agriculture and manufacturing, and the implications of these technologies for
CSM 547: Topics in Genetics
A survey of genetics organized around a particular topic, including gene regulation, developmental genetics, cancer genetics, epigenetics with emphasis on areas with emerging new insight. The methodology used to study these areas will also be explored. Intended for students in the MAT Biology and PhD Science Education programs. 3 credits, Letter graded (A, A-, B+, etc.)

CSM 548: Current Topics in Microbiology
A survey of microbiology with an emphasis on microbial ecology, the role of microbes in the biosphere and the methodology used to explore these areas. The course is organized around two resources available online: Unseen Life on Earth: An Introduction to Microbiology, which was produced by The American Society for Microbiology (http://www.learner.org/resources/series121.html) and the New York State core curriculum for The Living Environment (http://www.p12.nysed.gov/ciai/mst/sci/lss.html). Intended for the students in the MAT Science and MALS programs. This course has an associated fee. Please see www.stonybrook.edu/course fees for more information. 3 credits, Letter graded (A, A-, B+, etc.)

CSM 549: Laboratory Science Curriculum Development
Development of curriculum materials appropriate for a secondary school biology classroom. Students may take this course in their second semester of the Master of Arts in Teaching Science program. 1-6 credits, Letter graded (A, A-, B+, etc.) May be repeated 1 times FOR credit.

CSM 550: Independent Study in Biology
A research project or body of readings will be selected with an instructor. It is expected that participants will gain current information in a topic of interest with applicability to middle school or high school curriculum. Prerequisite: Permission of instructor 1-6 credits, Letter graded (A, A-, B+, etc.)

CSM 551: Polymerase Chain Reaction: Theory and Practice
The polymerase chain reaction (PCR) has become an indispensable tool in biology. PCR has revolutionized our approach to medical diagnostics, basic research, and forensic applications. This laboratory and lecture course is designed to teach a solid theoretical and practical framework for PCR, including primer and application protocol design, trouble-shooting, and interpretation of results. 3 credits, Letter graded (A, A-, B+, etc.)

CSM 552: Current Concepts in Neurobiology
Neurological disorders such as Parkinson's and Alzheimer's have been the center of much media attention recently. This lecture and laboratory course is designed to provide students with a basic overview of the brain and nervous system. Course participants will also utilize current approaches taken by research scientists to investigate the properties of the nervous system and its disorders. Laboratory activities that can be used in secondary school curricula will be emphasized. Prerequisite: Undergraduate degree in Biology 3 credits, Letter graded (A, A-, B+, etc.)

CSM 553: Biology and Human Social and Sexual Behavior
A biological theory of human uniqueness is presented and explored through the examination of empirical evidence from a multidisciplinary prospective including insights from ethology, human social and sexual behavior, evolutionary biology, history, economics, the humanities and political science. 3 credits, Letter graded (A, A-, B+, etc.)

CSM 554: Current Topics in Immunology
This is a comprehensive course in Immunology designed to be taught to secondary school teachers and it will address the new living environment curriculum standards for Immunology. The proposed course will combine lectures in Immunology with practical laboratory exercises. Laboratory activities will be provided that can be modified for secondary school education. Emphasis will be made on recent developments in Immunology and the essential role of the immune system in protection from infections and cancer. Concepts to be covered include how the immune system distinguishes self from non-self, how it handles various pathogens and why it sometimes fails. 3 credits, Letter graded (A, A-, B+, etc.)

CSM 555: Ecology
An examination of the interactions of living organisms with their physical and biological environments. Special attention is given to population dynamics and the interactions among organisms that determine the structure, function, and evolutionary development of biological communities. In addition, teacher candidates will conduct an independent project consisting of either a research paper or development of an ecology laboratory for a secondary school science class. 3 credits, Letter graded (A, A-, B+, etc.)

CSM 556: Forensic Science
Forensic science is focused upon the application of scientific methods and techniques to crime and law. In this course, scientific methods specifically relevant to crime detection and analysis will be presented. Emphasis is placed upon understanding the science behind the techniques used in evaluating physical evidence. Science MAT students or permission of the instructor. 3 credits, Letter graded (A, A-, B+, etc.)

CSM 562: Concepts in Chemistry K-8
This course provides participants with the necessary chemistry content needed to teach physical science applications at the upper elementary and middle school levels. The New York State Science and Learning Standards (NYSSLS) are utilized to provide a structure for the topics that teachers are required to teach within the new standards. In addition, the science and engineering practices and cross-cutting concepts addressed in NYSSLS are integrated within the discussion of chemistry.
content. During each lesson, chemical safety requirements are addressed and discussed. This course is designed to provide teachers with chemistry content required for the disciplinary core ideas of the NYSSLS standards through integration of activities, hands on learning and reading assignments.

3 credits, Letter graded (A, A-, B+, etc.)

CSM 599: Graduate Research in STEM Education
Research to be supported by a faculty member in the Programs in Science and STEM education. Prerequisite: Permission required.
Fall, 1-9 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

CSM 600: History and Philosophy of STEM Education
An introduction to the history of the field of STEM (science, technology, engineering, mathematics) and the related philosophical underpinnings. The course will survey the major events, ideas and philosophies and how these have changed over time. Particular focus will be on the time period from 1890 to the present day. Offered
Fall, 3 credits, Letter graded (A, A-, B+, etc.)

CSM 610: The Nature and Practice of Science
An overview of the nature and practice of science through the analysis of current issues in science. Through the extensive use of case studies, students will address questions such as: What is science? What distinguishes science from other ways of knowing? What standards of evidence and scientific explanations, processes, and conventions are used in science? What philosophical, social, ethical, and historical perspectives are important in understanding science?
Offered
Fall and Spring, 3 credits, Letter graded (A, A-, B+, etc.)

CSM 620: STEM Teacher Education
Introduction to the historical, philosophical and pedagogical issues surrounding STEM (science, technology, engineering, mathematics) teacher education. Introduction to the nature of the research that has been conducted on teacher education in the past and current trends. Offered
Spring, 3 credits, Letter graded (A, A-, B+, etc.)

CSM 630: STEM Education Research Seminar
Introduction to the major theoretical frameworks and paradigms in societal issues (gender, culture, and diversity) contextualized in STEM (science, technology, engineering, mathematics) education. Students will be required to critique research papers in the field and will conduct a literature review in their general thesis area. Offered
Fall and Spring, 3 credits, Letter graded (A, A-, B+, etc.)

CSM 635: Qualitative Research Methods in STEM Education
Introduction to qualitative research methods in STEM (science, technology, engineering, mathematics) education including a) its purposes, b) data collection techniques, c) methods of data analysis, and d) preparing appropriate research reports.
3 credits, Letter graded (A, A-, B+, etc.)

CSM 640: Directed Study in STEM Education
In their fifth semester students will individually complete a directed study with a faculty advisor. The intent of this course is to prepare the students for the doctoral qualifying examination and assist them in refining their research topics. Offered
Fall and Spring, 3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

CSM 645: Introduction to Quantitative Research Methods
This course will provide doctoral student with an introduction to various quantitative research methods (non-experimental, experimental, and quasi-experimental designs) and the corresponding data analysis/statistical procedures used for conducting empirical research in STEM (science, technology, engineering, mathematics) education. Appropriate statistical analysis associated with each research method will be discussed and SPSS assignments included. Students will develop a research proposal for a peer reviewed conference of journal.
3 credits, Letter graded (A, A-, B+, etc.)

CSM 650: Introduction to Measurement and Assessment in Science Education
CSM 650: Introduction to Measurement and Assessment in Science Education. 3 Credits. Introduction to core standards, concepts, and empirical methods in educational measurement and assessment: introduction to the development, use, and evaluation of measurement instruments in science education. Semesters Offered: Fall and Spring
3 credits, Letter graded (A, A-, B+, etc.)
May be repeated 1 times FOR credit.

CSM 699: Dissertation Research on Campus
Prerequisite: Must be advanced to candidacy (GS); major portion of the research will take place on SB campus, at Cold Spring Harbor; or at Brookhaven National Lab. Semesters offered:
Fall, 0-9 credits, S/U grading
May be repeated for credit.

CSM 700: Dissertation Research Off Campus-Domestic
Prerequisite: Must be advanced to candidacy (GS); major portion of the research will take place off Campus, but in U.S. and/or U.S. provinces. All international students must enroll in one of the graduate student insurance plans and should be advised by an International Advisor.
Fall, 1-9 credits, S/U grading
May be repeated for credit.

CSM 701: Dissertation Research Off Campus-International
Prerequisite: Must be advanced to candidacy (GS). Major portion of research will take place outside of the United States and/or U.S. provinces. Domestic students have the option of the health plan and may also enroll in MEDEX. International students who are in their home country are not covered by mandatory health plan and must contact the Insurance Office for the insurance charge to be removed. International students who are not in their home country are charged for the mandatory health insurance (if they are to be covered by another insurance plan they must file a waiver be second week of classes. The charge will only be removed if other plan is deemed comparable); all international students must receive clearance from an International Advisor.
Fall, 1-9 credits, S/U grading
May be repeated for credit.

CST

Cultural Studies

CST 502: Theories in Cultural Studies
This course examines the role of theory in the practice of cultural studies. 3 credits.
3 credits, Letter graded (A, A-, B+, etc.)
May be repeated 1 times FOR credit.

CST 510: History of Cultural Studies
This course will examine the intellectual and disciplinary stakes of raising the question,
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"what is Cultural Studies?" The intention is not so much to define Cultural Studies as to study the polemics and histories that sparked its delineations.

Offered Fall/Spring, 3 credits, Letter graded (A, A-, B+, etc.)
May be repeated 2 times FOR credit.

CST 597: Directed Readings for M.A. Students
A student and faculty member agree on a corpus of texts to read and discuss at weekly or biweekly meetings. The reading list must be filed with the program's form before the add/drop period ends. May be repeated for credit.
Fall and Spring, 1-3 credits, S/U grading
May be repeated for credit.

CST 598: Thesis Research
Research and writing of M.A. thesis supervised by faculty advisor.
Offered Fall, Spring, 1-3 credits, S/U grading
May be repeated for credit.

CST 599: Independent Study
A student and faculty member agree on a topic not offered in any seminars and a reading list to study at weekly or biweekly meetings. A final research paper or major annotated bibliography will be required. The syllabus must be filed with the program's form before the add/drop period ends. May be repeated for credit.
Only three credits of Independent Study can be counted toward the M.A. requirements, and a maximum of six toward the Ph.D.
Offered
Fall and Spring, 1-3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

CST 609: Advanced Topics in Cultural Studies
A variable topics seminar in Cultural Studies. 3 Credits, Letter graded (A, A-, B+, etc.) Course may be repeated as topics vary. Semesters Offered: Fall and Spring
3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

CST 680: Cultural Studies Research Seminar
In addition to readings on issues, debates, and problems within the profession and field of Cultural Studies students will develop research for publication while engaging with practices of professionalization.
Offered Fall/Spring, 3 credits, Letter graded (A, A-, B+, etc.)
May be repeated 2 times FOR credit.

CST 690: Directed Readings for Doctoral Candidates
A student and faculty member agree on a corpus of texts to read and discuss at weekly or biweekly meetings. The reading list must be filed with the program's form before the add/drop period ends. May be repeated for credit.
Fall and Spring, 1-12 credits, S/U grading
May be repeated for credit.

CST 696: Self-Directed Readings
For doctoral students who have completed all course requirements and wish to dedicate themselves to full or part-time preparation for the Comprehensive Examination.
Fall and Spring, 3-9 credits, S/U grading
May be repeated 6 times FOR credit.

CST 698: Practicum in Teaching
The course is divided into two parts: one half is normally given in the fall, one in the spring. The first part deals primarily with matters of pedagogy. The second part is designed to help students plan their own undergraduate courses. The practicum is required of all students during their first year.
3 credits, Letter graded (A, A-, B+, etc.)
May be repeated 2 times FOR credit.

CST 699: Dissertation Research on Campus
Prerequisite: Advancement to candidacy (G5). A portion of dissertation research must take place on SBU campus.
Fall, Spring, and Summer, 1-9 credits, S/U grading
May be repeated for credit.

CST 700: Dissertation Research Off Campus - Domestic
Prerequisite: Must be advanced to candidacy (G5). Major portion of research will take place off-campus, but in the United States and/or U.S. provinces. Please note, Brookhaven National Labs and the Cold Spring Harbor Lab are considered on-campus. All international students must enroll in one of the graduate student insurance plans and should be advised by an International Advisor.
Fall, Spring, 1-9 credits, S/U grading
May be repeated for credit.

CST 701: Dissertation Research Off Campus - International
Prerequisite: Must be advanced to candidacy (G5). Major portion of research will take place outside of the United States and/or U.S. provinces. Domestic students have the option of the health plan and may also enroll in MEDEX. International students who are in their home country are not covered by mandatory health plan and must contact the Insurance Office for the insurance charge to be removed. International students who are not in their home country are charged for the mandatory health insurance. If they are to be covered by another insurance plan they must file a waiver by second week of classes. The charge will only be removed if other plan is deemed comparable.

All international students must received clearance from an International Advisor.
Fall, Spring, 1-9 credits, S/U grading
May be repeated for credit.

CST 800: SUMMER RESEARCH
May be repeated for credit.

CST 850: SUMMER TEACHING
May be repeated for credit.

CWL
Creative Writing and Literature

CWL 500: Introduction to Graduate Writing
A seminar that introduces students to one another, the faculty, the program in Writing and Literature, and to issues in contemporary writing. Offered in conjunction with the Writers Reading Series. Students will attend the regular series of readings sponsored by the Writing program and meet at weekly intervals under the direction of a faculty advisor to discuss and write about topics raised in the lecture series, as well as issues generated from seminar discussions.
Offered Fall, Spring, 3-4 credits, Letter graded (A, A-, B+, etc.)

CWL 510: Forms of Fiction
Regular submission, discussion, and analysis of students' work in one or more of the modes of fiction, including the short story, the novella, and the novel. Writing assignments may include exercises, imitations, responses, and original work. Students will examine relevant works that illustrate point of view, character development, dialogue, plot, setting, theme, motif, and other aspects of fiction. Specific mode or topic to be studied will be announced in the course schedule.
Prerequisite: Permission of instructor and/or departmental consent
Offered Fall, Spring, 3-4 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

CWL 520: Forms of Poetry
Regular submission, discussion, and analysis of students' work in one or more of the modes of poetry. Writing assignments may include exercises, imitations, responses, and original work. Students will examine relevant works that illustrate structural principles, metrical and syntactical rhythm, sound and rhyme, formal and stanzaic organization, the use of figurative language, and other aspects of poetry.

Prerequisite: Permission of instructor and/or Program Director
Offered Fall, Spring, 3-4 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

CWL 530: Forms of Scriptwriting
Regular submission, discussion, and analysis of students' work in one or more of the contemporary modes of scriptwriting, including writing for film, theater, radio, and television. Writing assignments may include exercises, imitations, responses, and original work. Students will examine relevant works that illustrate the strategies available in modern professional communication. Specific mode or topic to be studied will be announced in the course schedule.

Prerequisite: Permission of instructor and/or departmental consent
Offered Fall, Spring, 3-4 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

CWL 535: Writing in Multiple Genres
Regular submission, discussion, and analysis of students' work in two or more genres of creative writing. Topics include Truth and Humor; Three Characters in Search of an Author; Imagining What You Know; What We Write About When We Write About Love; Fiction, Fact and the Heart of the Story; Writing about Place; Writing Everything; and Writing on Location. Semesters Offered: Fall & Spring Campus: Manhattan & Southampton
3-4 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

CWL 540: Forms of Creative Nonfiction
Regular submission, discussion, and analysis of students' work in one or more of the contemporary fields of non-fiction writing, including biography, autobiography, memoir, expository writing, and social commentary. Writing assignments may include exercises, imitations, responses, and original work. Students will examine relevant works that illustrate the methods and techniques available to the non-fiction writer. Specific mode or topic to be studied will be announced in the course schedule.

Prerequisite: Permission of instructor and/or departmental consent
Offered Fall, Spring, 3-4 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

CWL 550: Forms of Professional and Scientific Writing
Regular submission, discussion, and analysis of students' work in one or more of the contemporary modes of professional writing, including technological writing, writing about science, and writing for advertising, business, and public relations, as well as for governmental, educational, and professional organizations. Writing assignments may include exercises, imitations, responses, and original work. Students will examine relevant works that illustrate the strategies available in modern professional communication. Specific mode or topic to be studied will be announced in the course schedule.

Prerequisite: Permission of instructor and/or departmental consent
Offered Fall, Spring, 3-4 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

CWL 560: Topics in Literature for Writers
A seminar for writers concentrating on the study of one area of literary study, to be announced in the course schedule. The course may examine a contemporary or historical trend in literature, the rise of a specific genre, a social issue expressed in literature, an issue in literary theory, or any other topic of relevance and concern to students of writing. The emphasis will be on scholarly analysis.

Offered Fall, Spring, 3-4 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

CWL 565: Special Topics in Writing
A seminar concentrating on a specific topic or concern in writing. The particular theme of the course will be announced in the course schedule. Topics may include, among others, studies of character development, the uses of humor, writing about place, finding one's voice, and narrative style. Written work will be supported by the reading of related texts.

Offered Fall, Spring, 3-4 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

CWL 570: Advanced Writing Workshop
The focus is on work in progress and the extension of the manuscript. The workshop is open to students interested in any form of writing. Students are encouraged to pursue their own writing interests while simultaneously being exposed to the work of others in varying genres. Regular writing is required, and vigorous analysis and discussion are encouraged. Strongly recommended for students preparing for the thesis.

Offered Fall, Spring, 3-4 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

CWL 575: Writers Conference
The Southampton Writers Conference is an intensive program of workshops in contemporary writing that includes lectures, readings, workshops, and panels featuring nationally distinguished authors who join the department's summer faculty. Graduate students in the program will assist in planning and running the Conference, and will have the option of taking a Conference workshop for credit. The Writers Conference will also encourage participation by visiting students, i.e., new writers, established writers, teachers of writing and editors, who will be admitted by application and may receive academic credit upon request.

1-6 credits. Letter graded (A, A-, B+, etc.)
May be repeated for credit.

CWL 580: Practicum in Arts Administration
Practicum in Arts Administration Under the guidance of a faculty advisor, students will learn the essentials of Arts administration. This may include assisting in the coordination of reading and lecture series, conference organization, or other writing and arts administration activities. 1-4 Credits. May be repeated for credit Prerequisites: Permission of instructor and program director SEMESTER: On Demand
1-4 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

CWL 581: Practicum in Teaching Writing
Students take the seminar in conjunction with teaching a section of first year composition. This course provides hands-on experience and instruction in the basics of writing pedagogy, including designing writing assignments, sequencing assignments, motivating writing, writing skill development and evaluating writing. Students will also be given a preliminary overview of the major theories driving composition pedagogy. 3 Credits. Prerequisites: Permission of instructor and program director SEMESTER: On Demand
1-4 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

CWL 582: Practicum in Publishing and Editing

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Under the guidance of the faculty advisor, students will be exposed to the hands-on process of editing and publishing a literary journal.

**Offered Fall, Spring, 1-4 credits, Letter graded (A, A-, B+, etc.)**

**May be repeated for credit.**

**CWL 588: Independent Study**

Independent studies in topics chosen by the student are arranged through an individual instructor.

1-6 credits, S/U grading

**May be repeated for credit.**

**CWL 599: Thesis**

CWL 599 Thesis Every student in the M.A. program in Creative Writing and Literature must complete a thesis that is a publishable, book-length work. It may be fiction, nonfiction, poetry, a series of related short pieces, or some other creative writing project. The thesis is judged solely on the quality of its intelligence and its writing. Every student will propose a thesis project and upon approval will work independently under the guidance of faculty mentors. Additional resources such as meetings with faculty, editors, or agents will be equally available to students. Thesis study culminates will a group reading and submission of a bound copy of the thesis to the program. 1 - 9 Credits. Prerequisites: Permission of program

**SEMESTER: Every Semester**

1-9 credits, S/U grading

**May be repeated for credit.**

**CWL 600: Post MFA Creative Writing Fellow**

CWL 600 provides students who have successfully completed the MFA in Creative Writing and Literature degree requirements access to an intellectual community of writers. Participants will be allowed to participate in one workshop or course per semester on a space available basis. The program office will communicate with enrollees prior to the start of the semester the workshops and courses available.

S/U grading

**May be repeated for credit.**

**CWL 800: Summer/Winter Research**

Independent reading, writing, research on topics or problems related to work on the MFA Thesis.

Prerequisite: Permission of instructor and/or program director

Summer, S/U grading

**May be repeated for credit.**

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**DAN**

**Dance**

**DAN 501: Yoga and Somatics**

A practicum in the ancient Indian philosophy of yoga approached from the somatic perspective of equally conditioning the physical, psychical, and discriminating mental body. Moments of harmonious action within the human system will be investigated through the physical challenges of Hatha Yoga. Participants will learn dynamic movement sequences, static poses, and breathing techniques, as they relate to the varied historical lineages from India. The student will gain experiential knowledge of yoga as used for healing pain, improving body image through somatic awareness, prevention of mental and physical disease, muscular control, and as training to balance strength and flexibility. Although the course will focus primarily on the physical experience, related texts will be used to contextualize modern practices and familiarize the student with the extent of varied methodologies available.

**Offered Fall and Summer, 3 credits, Letter graded (A, A-, B+, etc.)**

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**DCS**

**Data and Computational Science**

**DCS 501: Quantum Computing and Applications**

This course is an introduction to and survey of the Quantum Computing, an emerging interdisciplinary field of science which has the potential to revolutionize computation over the next ten years, to transform chemistry, medicine, engineering and communications, as well as to change our understanding of physical world. The course will build intuitive approach to quantum computation and algorithms, but also will advance relevant vocabulary and skills for faculties and graduate students in engineering, computing, applied mathematics, chemistry, physics and related sciences. The key questions of the quantum computing will be introduced. How to describe quantum systems and quantum operations? What is a quantum computer and what are the limits of quantum power? What is the difference between classical and quantum computation? Quantum teleportation? Quantum entanglement and supersposition? How to mitigate errors and decoherence and transmit information through noisy channels? What are business applications and engineering challenges of the quantum computers? What are the gains in running quantum vs. classical algorithms? What are the physical principles of the current quantum computers hardware and what are technology requirements for realistic quantum computers?

3 credits, Letter graded (A, A-, B+, etc.)

**DCS 504: Compiler Design**

This course covers advanced topics in compiler, including memory management, dataflow analysis, code optimization, just-in-time compilation, and selected topics from compilation of object-oriented and declarative languages. Prerequisites: CSE 304 and CSE 307

3 credits, Letter graded (A, A-, B+, etc.)

**DCS 521: Introduction to Computational and Data Science**

This course provides a foundation of knowledge and basic skills for the successful application in graduate research of modern techniques in computational and data science relevant to engineering, the humanities, and the physical, life and social sciences. It is consciously crafted to provide a rich, project-oriented, multidisciplinary experience that establishes a common vocabulary and skill set. Centered around the popular programming language Python, the course will serve as an introduction to programming including data structures, algorithms, numerical methods, basic concepts in computer architecture, and elements of object-oriented design. Also introduced will be important concepts and tools associated with the analysis and management of data, both big and small, including basic statistical modeling in R, aspects of machine learning and data mining, and visualization. No previous computing experience is assumed. Students are assumed to have taken some introductory courses in two of these three math subjects: linear algebra, calculus, and probability.

3 credits, Letter graded (A, A-, B+, etc.)
This course provides students with foundational skills and knowledge in practical scientific programming relevant for scientists and engineers. The primary language is C++ since it is a widely-used, object-oriented language, includes C as a subset, and is a powerful tool for writing robust, complex, high-performance software. Elements of Python, Bash, and other languages will be introduced to complement the capabilities of C++, and essential tools for software development and engineering will be employed throughout the course (e.g. makefiles, version control, online code repositories, debugging, etc.).

**DCS 525: Fundamentals of Computing**
Introduction to several modern approaches for developing computer programs and their use to solve mathematical problems. It will cover the fundamentals of programming in MATLAB, Python, and C/C++, including scripting, basic data structures, algorithms, scientific computing, performance optimization, software engineering and program development tools. No previous programming experience is required. This is a project-based, 3-credit course. Homework projects will focus on using computation to solve mathematical problems (e.g. linear algebra and differential equations), data management, data analysis, etc.

3 credits, Letter graded (A, A-, B+, etc.)

**DCS 544: Computational Methods in Physics and Astrophysics**
An introduction to procedural and object-oriented programming in a high-level language such as C++ or modern Fortran with examples and assignments consisting of rudimentary languages to motivate and illustrate applications. Empirical phenomena in physics and astronomy. Students will use the UNIX/Linux operating system to write programs and manage data, and the course will include an introduction to parallel computing and good programming practices such as version control and verification. The course will prepare students for courses in algorithms and methods that assume a knowledge of programming.

3 credits, Letter graded (A, A-, B+, etc.)

**DCS 569: Bayesian Data Analysis and Computation**
An applied course in Bayesian data analysis and hierarchical modeling for advanced graduate students in Ecology & Evolution or related sciences. Topics will include probability theory, Bayesian analysis, and MCMC methods such as Gibbs sampling and Metropolis-Hastings sampling, as well as applied issues regarding the choice of prior distributions, posterior convergence, censored and missing data, and model checking and comparison. The course will be taught using WinBUGS and JAGS as accessed via the R packages R2WinBUGS and R2jags, respectively.

4 credits, Letter graded (A, A-, B+, etc.)

**DCS 572: Geophysical Simulation**
Basic equations and boundary conditions. Linear and nonlinear instabilities. Finite difference and time integration techniques for problems in geophysical fluid dynamics. Numerical design of global atmospheric and ocean models.

3 credits, Letter graded (A, A-, B+, etc.)

**DCS 581: Phase Transformations**
Thermodynamics and kinetics of solid state phase transformations. Mathematical formulation of equilibrium conditions and application to multicomponent homogenous/heterogeneous systems using chemical potential surfaces and free energy diagrams. Common tangent construction involving multiphase equilibria and miscibility gaps. Kinetics of phase transformations including classical nucleation theory followed by diffusion and diffusionless growth mechanisms.

3 credits, Letter graded (A, A-, B+, etc.)

**DCS 590: Introduction to Advanced Computational Social Science**
A multidisciplinary introduction to computational social science (CSS), emphasizing how social scientists develop and utilize computational-related social theory and methods to understand and analyze social behavior in the digital era. Topics include the CSS history and its latest development as well as how to use computational methods to collect, process, analyze, and visualize large-scale data from the real-world for social problems. This course also introduces state-of-the-art tools such as Python, R, and its scientific libraries for web-scraping, natural language processing, topic modeling, network analysis, and machine learning for text, image, and video data.

3 credits, Letter graded (A, A-, B+, etc.)

**DPA 505: Earth & Life Through Time: Vert Paleo (Turkana Basin)**
This course is one of five that constitute the Advanced Graduate Certificate in Human Origins at the Turkana Basin Institute in Kenya. Vertebrate fossils are important sources of information about the appearance, evolution, and extinction of major organisms. As such, they provide a valuable window into changes in climate and selection pressures, and organisms’ diverse adaptive responses to these changes. They are also significant in placing hominin discoveries within a relative local chronology and helping reconstruct environments associated with hominin remains. This course acquaints students with methods of vertebrate paleontology employed in different chronological contexts of the Turkana Basin and their use in addressing diverse theoretical questions.

3 credits, Letter graded (A, A-, B+, etc.)

**DPA 513: Origins of Agriculture**
This course will trace the history of anthropological thought on the origins of agriculture and will assess the evidence from the Old and New worlds for this economic revolution. The course will not only explore areas where early agriculture is evidenced, but will also contrast these areas with those where agriculture was a later development. Emphasis will be on the environmental, technological, biological, social, and cultural processes associated with the "Neolithic Revolution." This course is offered as both ANT 513 and DPA 513.

Fall, 4 credits, Letter graded (A, A-, B+, etc.)

**DPA 514: Human Osteology**
A detailed study of the anatomy of the human skeleton with special emphasis on the interpretation of skeletal remains from archaeological contexts. Consideration is given to the growth, structure, and function of bones, and to forensic aspects such as the determination of age, sex, stature, and pathology from skeletal remains. Students conduct a research project on a human skeleton. Prerequisites: Previous course in human or vertebrate anatomy and permission.

3 credits, Letter graded (A, A-, B+, etc.)
of instructor. Alternate years, 4 credits, Letter graded (A, A-, B+, etc.)
3 credits, Letter graded (A, A-, B+, etc.)
May be repeated 2 times FOR credit.

DPA 515: Approaches in Archaeology
Theoretical and methodological approaches employed in archaeology. The goals of the course are to provide an historical perspective on the growth of theory and method in archaeology and to examine in detail some of the pertinent research topics being studied today. This course is offered as both ANT 515 and DPA 515.
Fall, 4 credits, Letter graded (A, A-, B+, etc.)

DPA 516: Research Design in Archaeology
An examination of the ways in which archaeologists develop successful research strategies for arriving at answers to the key questions in the field. Students will analyze grant proposals that received funding from the major sources of funding for archaeology before developing research proposals of their own. The aim of the course is to provide the class with the skills needed to plan their future and compete successfully for funding both for their thesis research and in their future careers.
Fall, alternate years, 3 credits, Letter graded (A, A-, B+, etc.)

DPA 518: Lithic Technology
A detailed overview of the methods archaeologists use to extract behavioral information from prehistoric stone tools. The course examines raw material economy, technological strategies, tool use, and discard behavior. Analytical methods are practiced through the computer-assisted analysis of stone tools from simulated archaeological sites.
Spring, 3 credits, Letter graded (A, A-, B+, etc.)

DPA 519: Zooarchaeology
An introduction to the study of animal bones from archaeological sites. Special emphasis is on identification of fragmented bone, identification of bone surface modification, calculation of indexes of abundance, and measurement and metrical analysis of mammal bone. Computer analysis is stressed, and the class seeks to synthesize traditional zooarchaeological and actualistic studies. This course is offered as both ANT 519 and DPA 519.
4 credits, Letter graded (A, A-, B+, etc.)

DPA 525: Research Areas in Anthropological Sciences
An overview of the current research areas of the Anthropological Sciences as represented in the IDPAS. All first-year students of Anthropological Sciences are expected to participate. Semesters Offered: Fall Grading: S/U
0-1 credits, S/U grading
May be repeated 1 times FOR credit.

DPA 527: Field Methods and Techniques in Archaeology
An opportunity to participate in all aspects of an archaeological research project. Students develop practical skills in excavation, and design and execute plans for recording, artifact retrieval, surveying, field sorting techniques, and interpretation. This course involves faculty-led excavation of a prehistoric or early historic site. This course is offered as both ANT 527 and DPA 527. Prerequisite: Graduate standing or permission of instructor
3-9 credits, Letter graded (A, A-, B+, etc.)

DPA 535: Ethnoarchaeology
Ethnoarchaeology uses observations of present-day peoples to inform archaeological inquiry. This course helps students to explore ways in which ethnoarchaeological data contribute to several aspects of archaeological research: hypothesis building, survey and excavation strategies, interpretation of site and artifact data, and understanding the causes and processes of human behavioral change. In addition to seminar discussions of theoretical issues and case studies, students complete a book review of a monograph-length ethnoarchaeological study, a practical exercise in collecting and interpreting ethnoarchaeological data, and a term paper.
4 credits, Letter graded (A, A-, B+, etc.)

DPA 536: Phylogenetic Comparative Methods for trait evolution
The course provides an overview of biostatistical approaches that are used to estimate phenotypic trait evolution and provides participants with a springboard to using these methods to answer their own research questions. This course focuses on analyses that use a phylogenetic tree and observed trait information from tip taxa (extant and/or extinct) to describe how traits have changed along the branches of a phylogeny. The course covers methods that account for phylogenetic relatedness in standard parametric tests and methods that use models of evolution to infer how traits have changed along branches of phylogeny. The course will involve substantial preparation and take-home assignments. Students will become proficient in R programming.
3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

DPA 541: Evolutionary Anatomy
A lecture and laboratory with emphasis on dissection of the entire human body. Includes functional and comparative anatomy with special emphasis on the musculoskeletal morphology of humans and higher primates. This course is offered as both DPA 541 and HBA 541. There is a lab fee associated with this course. 8 credits, Letter graded (A, A-, B+, etc.)

8 credits, Letter graded (A, A-, B+, etc.)

DPA 555: Ancient African Civilizations
The archaeology of Africa’s later prehistoric and historic periods offers exciting contributions to global debates on the origins of agriculture and civilization. Covering the last 30,000 years, this course begins by examining the economic underpinnings of Africa’s early complex societies: intensive hunting & gathering, animal domestication, and early farming. Detailed case studies of five ancient civilizations (Egypt, Aksum, Jenne, Swahili, and Great Zimbabwe), and then explore distinct processes of prehistoric social change in different parts of Africa. The course concludes by discussing African archaeological heritage conservation, education and synthesis. Beyond these main themes, we develop additional units and discussions on topics of special interest to the students enrolled.
4 credits, Letter graded (A, A-, B+, etc.)

DPA 557: Building Bones: Bone Development and Evolution
An overview of the evolution, development, and growth of the skeleton, with a focus on mammals, primates, and humans. Students will review fundamental bone biology concepts, then read and discuss classic and current research on the evolution of bone development and the developmental basis for specific evolutionary changes in bone morphology. While much bone biology research has been completed in animal models, this course specifically builds a foundation for students to understand and critique current studies on the evolution and development of primate and human skeletal morphology. Within this context, students independently complete a literature review of the potential developmental and genetic basis for evolutionarily relevant variation of a skeletal phenotype, then propose research to help test these hypothetical relationships. Prerequisites: Instructor Consent
3 credits, Letter graded (A, A-, B+, etc.)
DPA 559: Archaeology of Food
Explores the archaeological study of food and foodways. The emphasis is on the social aspects of food, particularly its roles in past power structures, social relationships, conceptions of identity, ritual practices, and gender roles. Also covers the theoretical and methodological approaches archaeologists use to study food in the past.
*Fall, alternate years, 3 credits, Letter graded (A, A-, B+, etc.)*

DPA 560: Ancient Mesopotamia
An examination of the cultural history of Mesopotamia based on the archaeological, textual and art historical record. Focusing on the fourth through second millennia, this course investigates both the long term developmental process of this civilization, and ways to understand its settlement systems, urban structure, social and political organization, economic structure and the role played by religion.
*Fall, alternate years, 4 credits, Letter graded (A, A-, B+, etc.)*

DPA 563: Aspects of Animal Mechanics
An introduction to biomechanics. Covers freebody mechanics and kinetics as applied to vertebrate locomotion. Considers the structure and physiology of muscle as it relates to adaptations of the musculoskeletal system. This course is offered as both HBA 563 and DPA 563.
*Prerequisites: Introductory physics and biology or permission of instructor.
Spring, odd years, 2 credits, Letter graded (A, A-, B+, etc.)*

DPA 564: Primate Evolution
The taxonomic relationships and evolutionary history of primates as documented by their fossil record and structural and chemical evidence. Emphasis on primates prior to the origin of the human lineage. This course is offered as both ANG 564, DPA 564 and HBA 564. 4 credits, Letter graded (A, A-, B+, etc.)
*4 credits, Letter graded (A, A-, B+, etc.)*

DPA 565: Human Evolution
A survey of the fossil record of hominid evolution through the Pliocene and Pleistocene with emphasis on the morphological structure and function of locomotor, masticatory, and neural systems. Includes utilization of comparative anatomical material and an extensive cast collection. This course is offered as ANG 565, DPA 565 and HBA 565. 4 credits, Letter graded (A, A-, B+, etc.)
*4 credits, Letter graded (A, A-, B+, etc.)*

DPA 566: Studies in Functional Morphology
Introduction to the theory and methods of functional morphology. Various methods of analysis and the application of experimental techniques such as electromyography or bone strain analysis are discussed as they pertain to the understanding of the interaction between form and function. Special emphasis is placed on the analysis of human and nonhuman primate morphology, and the application of this analysis to interpretation of the fossil evidence for human and nonhuman primate evolution. This course is offered as both HBA 566 and DPA 566.
*Prerequisite: Permission of instructor.
Spring, even years, 2 credits, Letter graded (A, A-, B+, etc.)*

DPA 567: Primate Behavior and Ecology
A comparative approach to the behavior and ecology of living lemurs, monkeys, and apes. Emphasis is placed on sociobiological theory: life history strategies; morphological adaptations; comparisons of primate communities in Africa, Madagascar, and South America; and primate conservation. This course is offered as both ANG 567 and DPA 567.
*Fall, odd years, 4 credits, Letter graded (A, A-, B+, etc.)*

DPA 568: Comparative Primate Anatomy
The comparative anatomy of living primates. Laboratory dissection with emphasis on relating structural diversity to behavior and biomechanics. This course is offered as both HBA 582 and DPA 582. 4 credits, Letter graded (A, A-, B+, etc.)
*4 credits, Letter graded (A, A-, B+, etc.)*

DPA 569: Professional Skills in the Anthropological Sciences, I.
An overview of the skills necessary for scientific professionalism, with special reference to successful performance in the Anthropological Sciences. Topics covered in this course include: use of basic software tools, research design, data collection and management, dissertation proposal and journal article writing, oral and poster presentations, and professional conduct. This course is not an alternative to GRD 500. Recommended for students of G0 through G4 status. Permission by Instructor.
*0-1 credits, S/U grading. May be repeated for credit.*

DPA 570: Professional Skills in the Anthropological Sciences, II.
A development of additional professional skills necessary to master research and teaching in the Anthropological Sciences including career options and employment. Topics in this course include: the dissertation writing process, review processes, job applications and negotiations, tenure process, and teaching strategies. Recommended for students of G5 status. Permission by Instructor.
*0-1 credits, S/U grading. May be repeated for credit.*

DPA 591: Professional Skills in the Anthropological Sciences
An overview of the skills necessary for scientific professionalism, with special reference to successful performance in the Anthropological Sciences. Topics covered in this course include: use of basic software tools, research design, data collection and management, dissertation proposal and journal article writing, oral and poster presentations, and professional conduct. This portion of the course incorporates videos and readings from GRD 500. Anthropology-specific topics include fieldwork, museum work, animal research, US and international laws (biodiversity; cultural & natural heritage), and public anthropology. Anthropological Sciences faculty with particular expertise in these various areas lead these discussions.
*0-1 credits, S/U grading. May be repeated for credit.*

DPA 600: Practicum in Teaching
May be repeated for credit.

DPA 602: Research Seminar in Anthropological Theory
This course is offered as both ANG 602 and DPA 602.
*Fall and Spring, 0-12 credits, S/U grading. May be repeated for credit.*

DPA 610: Individual Research
Research supervised by faculty. Students must have permission of instructor and enroll in appropriate section. This course is offered as both ANG 610 and DPA 610.
*Fall and Spring, 1-12 credits, S/U grading. May be repeated for credit.*

DPA 620: Research Seminar in Topical Problems
This course is offered as both ANG 620 and DPA 620.
*Fall and Spring, 3 credits, S/U grading. May be repeated for credit.*
DPA 630: Research Seminar in Physical Anthropology
This course is offered as both ANT 630 and DPA 630. Fall and Spring, 3 credits, S/U grading. May be repeated for credit.

DPA 650: Research Seminar in Archaeology

DPA 680: Special Seminar
Selected topics in cultural and social anthropology. Topics reflect current interests of faculty and graduate students. This course is offered as both ANT 680 and DPA 680. Fall and Spring, 1-3 credits, S/U grading. May be repeated for credit.

DPA 699: Dissertation Research on Campus
Prerequisite: Must be advanced to candidacy (G5). Major portion of research must take place on SBU campus, at Cold Spring Harbor, or at the Brookhaven National Lab. Fall, Spring, and Summer, 1-9 credits, S/U grading. May be repeated for credit.

DPA 700: Dissertation Research off Campus - Domestic
Prerequisite: Must be advanced to candidacy (G5). Major portion of research will take place off-campus, but in the United States and/or U.S. provinces. Please note, Brookhaven National Labs and the Cold Spring Harbor Lab are considered on-campus. All international students must enroll in one of the graduate student insurance plans and should be advised by an International Advisor. Fall, Spring, 1-9 credits, S/U grading. May be repeated for credit.

DPA 701: Dissertation Research off Campus - International
Prerequisite: Must be advanced to candidacy (G5). Major portion of research will take place outside of the United States and/or U.S. provinces. Domestic students have the option of the health plan and may also enroll in MEDEX. International students who are in their home country are not covered by mandatory health plan and must contact the Insurance Office for the insurance charge to be removed. International students who are not in their home country are charged for the mandatory health insurance. If they are to be covered by another insurance plan they must file a waiver be second week of classes. The charge will only be removed if other plan is deemed comparable.

All international students must receive clearance from an International Advisor. Fall, Spring, 1-9 credits, S/U grading. May be repeated for credit.

DPA 800: Summer Research
This course is offered as both ANT 800 and DPA 800. S/U grading. May be repeated for credit.

ECO Economics

ECO 500: Microeconomics I
The first semester of a one-year course in microeconomic theory. Deals with decision-making of economic agents in different choice environments using the analytical approach of duality theory. Topics include theory of the consumer, theory of the firm, decision-making under risk and uncertainty, intertemporal choice, aggregation, and capital theory. Prerequisite: Graduate standing in the Economics Department or permission of the Graduate Director. Fall, 3 credits, Letter graded (A, A-, B+, etc.)

ECO 501: Microeconomics II
A continuation of ECO 500, focusing on theories of equilibrium and market structure. Topics include general competitive equilibrium, imperfect competition and game theory, imperfect information, theory of public goods, and social choice. Prerequisite: ECO 500, Graduate standing in the Economics Department or permission of the Graduate Director. Spring, 3 credits, Letter graded (A, A-, B+, etc.)

ECO 510: Macroeconomics I
The first semester of a one-year course in macroeconomic theory. Deals with theories and determinants of income, employment, and inflation. Topics include static equilibrium models, theories of money demand and monetary phenomena, theories of the labor market and unemployment, rational expectations and stabilization policy, consumption, and investment. Prerequisite: ECO 510, Graduate standing in the Economics Department or permission of the Graduate Director. Fall, 3 credits, Letter graded (A, A-, B+, etc.)

ECO 511: Macroeconomics II
A continuation of ECO 510, focusing on dynamic models. Topics include models of economic growth, optimal growth and efficiency, overlapping-generations models, rational expectations, and optimal policy. Prerequisite: ECO 510, Graduate standing in the Economics Department or permission of the Graduate Director. Spring, 3 credits, Letter graded (A, A-, B+, etc.)

ECO 520: Mathematical Statistics
The first semester of a one-year course in quantitative methods. Statistical methods and their properties of particular usefulness to economists. Topics include probability theory, univariate and multivariate distributions, limiting distributions, point and interval estimation, hypothesis testing. Prerequisite: Graduate standing in the Economics Department or permission of the Graduate Director.

ECO 521: Econometrics
A continuation of ECO 520. The application of mathematical and statistical methods of economic theory, including the concept of an explanatory economic model, multiple regression, hypothesis testing, simultaneous equations models, and estimating techniques. Prerequisite: ECO 520, Graduate standing in the Economics Department or permission of the Graduate Director.

ECO 522: Applied Econometrics
A continuation of ECO 521. The application and extension of econometric techniques developed in ECO 521. Emphasis on the relationship among economic theory, econometric modeling and estimation, and empirical inference. Computer usage for calculation of estimators. Critical examination of econometric studies in current journals. Prerequisite: ECO 521, Graduate standing in the Economics Department or permission of the Graduate Director.

ECO 531: Introduction to Computational Methods in Economics
A first course in the computational and graphical techniques for finding numerical solutions to a set of economic models (from more elementary models such as Edgeworth Box to a more general competitive equilibrium model to finding the policy function of a dynamic growth model) based on concepts and constructs presented in the 1st year graduate theory courses. Includes the foundations of programming (using a symbolic algebra language), and finding maxima of functions, finding equilibria of markets, and exploring and fitting functions graphically and through finite difference and projection methods.
**ECO 604: Game Theory I**

Refinements of strategic equilibrium, games with incomplete information, repeated games with and without complete information, and stochastic games. The Shapley value of games with many players, and NTU-values. This course is offered as both ECO 605 and AMS 555.

Prerequisite for AMS 555: AMS 552/ECO 604. Spring, 3 credits, Letter graded (A, A-, B+, etc.)

**ECO 605: Game Theory II**

Refinements of strategic equilibrium II, games with incomplete information, repeated games with and without complete information, and stochastic games. The Shapley value of games with many players, and NTU-values. This course is offered as both ECO 605 and AMS 555.

Prerequisite for AMS 555: AMS 552/ECO 604. Fall, 3 credits, Letter graded (A, A-, B+, etc.)

**ECO 606: Advanced Topics in Strategic Behavior in Economics**

An analysis of varying topics in strategic behavior in economics. One or more of the following topics and others will be dealt with each week: repeated games with incomplete information; stochastic games; bounded rationality complexity and strategic entropy; values of non-atomic games; strategic aspects in the telecommunication industry; general equilibrium and financial markets; auction mechanisms; knowledge, common knowledge, and strategic equilibria.

Prerequisites: ECO 501, ECO 604, ECO 605, or permission of instructor. Graduate standing in the Economics Department or permission of the Graduate Director. Fall or Spring, 3 credits, Letter graded (A, A-, B+, etc.)

May be repeated for credit.

**ECO 607: Masters Project in Economics**

In this required course students will work with an adviser of their choice to write a paper to be submitted by the end of the semester. This research piece will be a well-structured and coherent article on an economic research question in a field of the student's choice, with some elements of originality. The paper cannot be just an extended example that carries out known techniques on a problem that has known answers even if those techniques are complicated. The approval of the master's project advisor and the Graduate Program Director are required to register for this class. Offered fall and spring, 0-3 credits, S/U grading.

**ECO 608: Game Theory I**

Elements of cooperative and non-cooperative games. Matrix games, pure and mixed strategies, and equilibria. Solution concepts such as core, stable sets, and bargaining sets. Voting games, and the Shapley and Banzhaff power indices. This course is offered as both ECO 604 and AMS 552. Prerequisite for ECO 604: Graduate standing in the Economics Department or permission of the Graduate Director. Fall or Spring, 3 credits, Letter graded (A, A-, B+, etc.)

**ECO 609: Game Theory II**

Refinements of strategic equilibrium, games with incomplete information, repeated games with and without complete information, and stochastic games. The Shapley value of games with many players, and NTU-values. This course is offered as both ECO 605 and AMS 555.

Prerequisite for AMS 555: AMS 552/ECO 604. Spring, 3 credits, Letter graded (A, A-, B+, etc.)

**ECO 610: Special Topics: Advanced Macroeconomics Theory**

Topics in macroeconomic theory, including microfoundations of macroeconomics, temporary general equilibrium and disequilibrium, monetary theory, equilibrium theory of business cycles, implicit contracts, rational expectations, and econometric implications. Prerequisites: ECO 501, ECO 511, Graduate standing in the Economics Department or permission of the Graduate Director. Semesters Offered: Fall and Spring, 3 credits, Letter graded (A, A-, B+, etc.)

May be repeated 3 times FOR credit.

**ECO 611: Computational Economics**

An analysis of the theory and applications of the dynamic modeling literature using computational methods, and on the methods themselves. Dynamic Modeling and Computational Economics are possibly the fastest growing areas of interest in the profession due to its suitability to model, solve and also estimate realistic decision making problems in most areas of economics.

Prerequisite: Graduate standing in the Economics Department or permission of the Graduate Director. Fall, 3 credits, Letter graded (A, A-, B+, etc.)

**ECO 612: Computational Macroeconomics**

A concentration on numerical methods commonly used to solve dynamic macroeconomic models. These include methods relying on dynamic programming techniques, linear approximation methods, and non-linear methods that can be applied to models with distortions and heterogeneous agents. The different methods will be explained and their application to macroeconomics will be illustrated with examples from various areas such as Real Business Cycles, Asset Pricing with Complete and Incomplete Markets, and Recursive Contracts.

Prerequisite: ECO 612, Graduate standing in the Economics Department or permission of the Graduate Director. Spring, 3 credits, Letter graded (A, A-, B+, etc.)

**ECO 613: Advanced Macroeconomics workshop**

This course is designed for PhD students in their 2nd year and above who are thinking about writing a dissertation in macroeconomics. The course will provide the students with research methods for finding a PhD topic as well as for developing their preliminary ideas for their dissertation topic. The course will involve presentations not only from faculty members but also from students, allowing them to obtain direct feedback and direction for future research from all the faculty members in macroeconomics. The course will also provide students with reviews of the most important literature through discussions and presentations by the faculty members of seminal papers in the cutting edge research areas in macroeconomics. Some examples of these areas are consumer bankruptcy, Housing Markets, Social Security Reform, Health Care reform and Tax reform. The course will deal with stochastic, dynamic general equilibrium models which do not have a close form solution. Students will have to use these models to study their question of interest and the course will also provide them with direction as to which numerical methods are more appropriate to solve their particular problems.

Fall and Spring, 0-3 credits, Letter graded (A, A-, B+, etc.)

May be repeated 4 times FOR credit.

**ECO 614: Advanced Macroeconomics**

This course is designed for PhD students in their 2nd year and above who are thinking about writing a dissertation in macroeconomics. The course will provide the students with research methods for finding a PhD topic as well as for developing their preliminary ideas for their dissertation topic. The course will involve presentations not only from faculty members but also from students, allowing them to obtain direct feedback and direction for future research from all the faculty members in macroeconomics. The course will also provide students with reviews of the most important literature through discussions and presentations by the faculty members of seminal papers in the cutting edge research areas in macroeconomics. Some examples of these areas are consumer bankruptcy, Housing Markets, Social Security Reform, Health Care reform and Tax reform. The course will deal with stochastic, dynamic general equilibrium models which do not have a close form solution. Students will have to use these models to study their question of interest and the course will also provide them with direction as to which numerical methods are more appropriate to solve their particular problems.

Fall and Spring, 0-3 credits, Letter graded (A, A-, B+, etc.)

May be repeated 4 times FOR credit.
ECO 623: Introduction to Computational
Survey of major sources of data in economics and theoretical hypotheses and statistical methods for organizing and analyzing such data. Statistical models for quantitative data as well as qualitative choices are presented. Computer usage is expected.
Prerequisite: ECO 521; Graduate standing in the Economics department or permission of the Graduate Program Director.
Spring, 3 credits, Letter graded (A, A-, B+, etc.)

ECO 629: Studies in Quantitative Methods
Prerequisite: ECO 521; Graduate standing in the Economics department or permission of the Graduate Program Director.
Fall, 3 credits, Letter graded (A, A-, B+, etc.)

ECO 636: Industrial Organization I
Applications of microeconomic theory to the determinants of market structure. Relationships between market structure, firm behavior, and allocational efficiency. Econometric estimation and testing of some hypotheses suggested by the theory.
Prerequisites: ECO 501, ECO 521; Graduate standing in the Economics department or permission of the Graduate Program Director.
Fall, 3 credits, Letter graded (A, A-, B+, etc.)

ECO 637: Industrial Organization II
This course is a continuation of ECO 636. It deals with the same questions and tools as ECO 636, and provides an introduction to antitrust policy and to public policy toward industry, including regulation and deregulation, the design of optimal regulation, and the effectiveness of current regulation.
Prerequisites: ECO 501, ECO 521; Graduate standing in the Economics department or permission of the Graduate Program Director.
Fall, 3 credits, Letter graded (A, A-, B+, etc.)

ECO 640: Labor Economics I
This is the first course in the graduate sequence in labor economic theory and empirical applications. Topics include human capital theory, labor supply, life cycle behaviors, and the behavioral effects of social insurance programs. The emphasis is on up to date treatments of these topics in the literature. Offer
Fall, 3 credits, Letter graded (A, A-, B+, etc.)

ECO 641: Labor Economics II
This is an advanced course in labor economics which continues ECO 640. Topics include both theory and estimation of job search, matching, dynamic discrete and continuous choice models of the labor market. Special emphasis will be given to the role of economic theory in specification and testing econometric models.

ECO 642: Demographic Economics I
This course deals with the economics of the family. It utilizes recently developed techniques in economics and demography to deal with questions concerning marriage, divorce, fertility, contraception, the intrafamily distribution of resources, and the intergenerational distribution of resources. Students will do original theoretical and empirical research under the professor's supervision. Prerequisite: ECO 501; Graduate standing in the Economics department or permission of the Graduate Program Director.
Spring, 3 credits, Letter graded (A, A-, B+, etc.)

ECO 643: Demographic Economics II
This course is a continuation of ECO 642. It deals with the same questions and tools as ECO 642, but emphasizes developing economics. The connections between population growth and development are stressed.
3 credits, Letter graded (A, A-, B+, etc.)

ECO 645: Health Economics II
Critical reviews of research in health economics topics of current interest, such as empirical and conceptual models of physician behavior, competition in the pharmaceutical industry, the economic impacts of managed care, and the causes and consequences of unhealthy behaviors. Students will present and critique original research and produce a research paper on a topic of their interest.
3 credits, Letter graded (A, A-, B+, etc.)

ECO 646: Health Economics II
Theoretical and econometric analysis of selected aspects of the health care delivery system, such as the demand for medical services, the supply and distribution of physician services, the utilization of non-physician medical personnel, alternative models of hospital behavior, third-party insurance reimbursement, national health insurance and cost, and price inflation in the hospital and long-term care sectors. Offered as ECO 646 or HPH 664.
3 credits, Letter graded (A, A-, B+, etc.)

ECO 647: Research Methods in Applied Microeconomics
Presentation, discussion and analysis of student and faculty research in the areas of applied microeconomics, labor economics, health economics and industrial organization, as well as applied econometrics. The purpose of the course is to provide skills and feedback to students at various levels in the program that assist them toward the completion of their second year paper, dissertation proposals and thesis. It is a course in research and presentation methods that provides an effective mechanism for learning about current areas of research interest.
Prerequisite: Graduate standing in the Economics Department or permission of the Graduate Director
Fall or Spring, 0-3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

ECO 690: Seminar in Applied Economics
Preparation, presentation, and discussion of student and faculty research in applied economics. Topics covered by student papers are usually related to students' long-term research interests.
Fall or Spring, 0-6 credits, S/U grading
May be repeated for credit.

ECO 695: Research Workshop
Designed to direct students to the selection of dissertation topics. Oral & written presentation of student papers with active faculty participation. Several sections may be offered each semester in areas of broad research interest.
0-3 credits, S/U grading
May be repeated 4 times FOR credit.

ECO 696: Practicum in Teaching
Prerequisite: Graduate standing in the Economics department or permission of the Graduate Program Director.
Spring, 0-3 credits, S/U grading
May be repeated for credit.

ECO 699: Dissertation Research on Campus
Prerequisite: Have declared thesis advisor in Economics Ph.D. program (G5). Major portion of research must take place on SBU campus, at Cold Spring Harbor, or at the Brookhaven National Lab.
Fall, Spring, and Summer, 1-9 credits, S/U grading
May be repeated for credit.
EGO 700: Dissertation Research off Campus - Domestic
Prerequisite: Must be advanced to candidacy (G5). Major portion of research will take place off-campus, but in the United States and/or U.S. provinces. Please note, Brookhaven National Labs and the Cold Spring Harbor Lab are considered on-campus. All international students must enroll in one of the graduate student insurance plans and should be advised by an International Advisor.

Fall, Spring, 0-9 credits, S/U grading
May be repeated for credit.

EGO 701: Dissertation Research off Campus - International
Prerequisite: Must be advanced to candidacy (G5). Major portion of research will take place outside of the United States and/or U.S. provinces. Domestic students have the option of the health plan and may also enroll in MEDEX. International students who are in their home country are not covered by mandatory health plan and must contact the Insurance Office for the insurance charge to be removed. International students who are not in their home country are charged for the mandatory health insurance. If they are to be covered by another insurance plan they must file a waiver by second week of classes. The charge will only be removed if other plan is deemed comparable.

All international students must received clearance from an International Advisor.

Fall, Spring, 0-9 credits, S/U grading
May be repeated for credit.

ECO 800: Summer Research
Prerequisite: Pre-approved participation in Economics dept. activity.
S/U grading
May be repeated for credit.

EGL English

EGL 501: Studies in Chaucer

EGL 502: Studies in Shakespeare

EGL 503: Studies in Milton

EGL 505: Studies in Genre
May be repeated for credit.

EGL 506: Studies in Literary Theory
Prerequisite: Matriculation in a graduate program or the composition studies certificate.

3 credits, Letter graded (A, A-, B+, etc.)

EGL 509: Studies in Language and Linguistics

EGL 510: Old English Language and Literature

EGL 515: Middle English Language and Literature

EGL 520: Studies in the Renaissance

EGL 525: 17th-Century Literature

EGL 530: Studies in Restoration Literature

EGL 535: Studies in Neoclassicism

EGL 540: Studies in Romanticism

EGL 545: Studies in Victorian Literature

EGL 547: Late 19th-Century British Literature

EGL 550: 20th-Century British Literature

EGL 555: Studies in Irish Literature

EGL 560: Studies in Early American Literature

EGL 565: 19th-Century American Literature

EGL 570: 20th-Century American Literature

EGL 575: British and American Literature

EGL 582: Drama Workshop

EGL 583: Nonfiction Workshop
Participants will learn to compose, critique and revise nonfiction forms such as essays and memoirs, incorporating narrative techniques that will make their work accessible and engaging to general readerships.
3 credits, Letter graded (A, A-, B+, etc.)

EGL 584: Topics in Genre Studies

Changing issues in the historical study of particular genres, such as the novel, lyric poetry, film, drama, etc.

Fall, Spring, Summer, 3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

EGL 585: Topics in Cultural Studies
Changing issues in the interdisciplinary study of culture, including literature, popular culture, discourse studies, media studies, etc. Focus is on the analysis of historical contexts and on methods derived from contemporary cultural theory.

Fall, Spring, 3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

EGL 586: Topics in Gender Studies
Changing historical or theoretical focus on issues in gender studies, sexuality, queer studies, or women's writing.

Fall, Spring, 3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

EGL 587: Topics in Race, Ethnic, or Diaspora Studies
Changing historical or theoretical focus on issues of race or ethnicity, on U.S., British, or global ethnic literatures, or on experiences, histories, or theories of colonization, decolonization, empire, globalism, or diaspora.

Fall, Spring, Summer, 3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

EGL 588: Writing Workshop
Changing focus on various forms of writing, including poetry, drama, fiction, the essay, etc.

Fall, Spring, 3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

EGL 592: Problems in Teaching Writing or Composition
This course provides an overview of writing pedagogy as applied to tutoring in a Writing Center or in an English classroom. Included in the course is fieldwork in the campus Writing Center.

Fall, 3 credits, Letter graded (A, A-, B+, etc.)

EGL 594: Contexts of Literary Study

EGL 597: Practicum in Methods of Research

EGL 598: Thesis Research
Research and writing of M.A. thesis supervised by faculty advisor. 

EGL 599: Independent Study
May be repeated for credit.

EGL 600: Proseminar: The Discipline of Literary Studies
Pro-seminar: Introduction to critical analysis, including theoretical and methodological approaches, and an orientation to the profession both in the academy and other careers. Faculty members will speak on their own scholarship and professional experiences. 
3 credits, Letter graded (A, A-, B+, etc.)

EGL 601: Problems in History and Structure of the English Language
A survey of the English language from its historical beginnings through the present. 
3 credits, Letter graded (A, A-, B+, etc.)

EGL 602: Problems in Bibliography, Editing, and Textual Criticism
An introduction to the study of manuscripts and printed books, with special emphasis on editorial and textual problems and decisions. 
3 credits, Letter graded (A, A-, B+, etc.)

EGL 603: Problems in Literary Theory and Criticism
A seminar on any of the current theoretical approaches to texts. 
3 credits, Letter graded (A, A-, B+, etc.)

EGL 604: Problems in Literary Analysis
An introduction to the explication of texts. 
3 credits, Letter graded (A, A-, B+, etc.)

EGL 605: Problems in Convention and Genre
An examination of literary types and categories. 
3 credits, Letter graded (A, A-, B+, etc.)

EGL 606: Period and Tradition
An examination of the major issues that pertain to particular historical literary periods. 
3 credits, Letter graded (A, A-, B+, etc.)

EGL 607: Individual Authors
In depth study of specified writers, from Old English to Contemporary World Literatures in English. 
3 credits, Letter graded (A, A-, B+, etc.)

EGL 608: Problems in the Relationship of Literature to Other Disciplines
This seminar will encourage the interdisciplinary focus of our program by examining the intersection between textual studies and other forms of inquiry. 
3 credits, Letter graded (A, A-, B+, etc.)

EGL 610: Individual Authors
May be repeated for credit.

EGL 611: Critical Theory
A seminar on influential theoretical approaches to texts. 
3 credits, Letter graded (A, A-, B+, etc.)

EGL 612: Theories in Composition
This course explores the relationship between reading and writing skills, the differences between speech production and writing production, and the relationship between literacy, culture, and language politics. 
Spring, 3 credits, Letter graded (A, A-, B+, etc.)

EGL 613: Research in Composition
This course provides an introduction to the nature of empirical research in Composition Studies. Students will survey landmark research studies, learn how to read research reports critically, and conduct a mini-research project in their own classrooms or tutoring situations to analyze underlying causes of students' writing problems. 
Spring, 3 credits, Letter graded (A, A-, B+, etc.)

EGL 614: Topics in Composition and Writing
This course will consist of directed readings in particular areas of interest in rhetoric, the history of rhetoric and pedagogy, and teaching strategies for teachers. 
Offered Fall and Spring, 3 credits, Letter graded (A, A-, B+, etc.)

EGL 615: Independent Study
Semesters Offered: Fall and Spring 
0-3 credits, Letter graded (A, A-, B+, etc.)

EGL 620: Literary Studies Research and Writing Seminar
This course focuses on the research and writing skills necessary to submit work for publication. In addition to shared readings, students will conduct substantial new research and expand a paper they have previously written for a graduate seminar. Please note that this course cannot be taken until students have completed at least one semester of the doctoral program. 
3 credits, Letter graded (A, A-, B+, etc.)

EGL 688: Experiential Learning/Internship
This course is designed for students who engage in a substantial, structured experiential learning activity under the direction of a faculty member. Experiential learning occurs when knowledge acquired through formal learning and past experience are applied to a "real-world" setting or problem to create new knowledge through a process of reflection, critical analysis, feedback and synthesis. Beyond-the-classroom experiences that support experiential learning may include: service learning, field work, or an internship. The course is intended to foster professional development, helping students to apply and extend the specialized content knowledge and skills gained through academic coursework towards prospective careers in higher education or other sectors. 
0-3 credits, Letter graded (A, A-, B+, etc.)

EGL 690: Directed Readings
May be repeated for credit.

EGL 695: Methods of Teaching English

EGL 697: Practicum in Teaching English Literature
Teaching workshop for introductory courses in poetry, fiction, and drama. 
3 credits, S/U grading

EGL 698: Practicum in Teaching Writing
This course provides hands-on experience and instruction in the basics of writing pedagogy, including designing writing assignments, preparing assignments, motivating writing, writing skill development and evaluating writing. Students will also be given a preliminary overview of the major theories driving composition pedagogy. 
3 credits, Letter graded (A, A-, B+, etc.)

EGL 699: Dissertation Research on Campus
Prerequisite: Advancement to candidacy (G5). Major portion of research must take place on SBU campus, at Cold Spring Harbor, or at the Brookhaven National Lab.
EGL 700: Dissertation Research off Campus - Domestic
Prerequisite: Must be advanced to candidacy (G5). Major portion of research will take place outside of the United States and/or U.S. provinces. Please note, Brookhaven National Labs and the Cold Spring Harbor Lab are considered on-campus. All international students must enroll in one of the graduate student insurance plans and be advised by an International Advisor.
Fall, Spring, 1-9 credits, S/U grading
May be repeated for credit.

EGL 701: Dissertation Research off Campus - International
Prerequisite: Must be advanced to candidacy (G5). Major portion of research will take place outside of the United States and/or U.S. provinces. Domestic students have the option of the health plan and may also enroll in MEDEX. International students who are not in their home country are not covered by mandatory health plan and must contact the Insurance Office for the insurance charge to be removed. International students who are not in their home country are charged for the mandatory health insurance. If they are to be covered by another insurance plan they must file a waiver be second week of classes. The charge will only be removed if other plan is deemed comparable.

All international students must received clearance from an International Advisor.
Fall, Spring, 1-9 credits, S/U grading
May be repeated for credit.

EGL 800: SUMMER RESEARCH
May be repeated for credit.

EHM 502: Environmental Media, Film, Writing
An examination of a variety of genres - social media; advertising; film; video; photojournalism; fiction; children's literature; and non-fiction - in order to understand ways in which these texts are utilized to inform and manipulate public opinion regarding the environment. The culmination of the course will be a final research project using multiple genres.

Semesters offered:
Fall, Spring, 3 credits, Letter graded (A, A-, B+, etc.)

EHM 503: Ecofeminism
The course will examine ecofeminist critical theory from its inception in the early 1970s to the present. Ecofeminist thought will be utilized as the lens through which students read, research and study a wide variety of fiction and nonfiction literature, history, film, media and culture.
Semesters Offered:
Fall, 3 credits, Letter graded (A, A-, B+, etc.)

EHM 504: Environmental Justice
This course will examine a wide range of environmental issues such as climate change, toxic pollution, water and food rights, and more - within socioeconomic and racial contexts. The course will look at how underprivileged and nonwhite socioeconomic communities are most adversely impacted by environmental degradation in the U.S. and around the world.
Semesters Offered:
Fall, 3 credits, Letter graded (A, A-, B+, etc.)

EHM 505: Environmental Narrative Nonfiction
A study of the literary genre of environmental narrative nonfiction, which includes a blend of scientific and historical fact and creative expression and memoir. Students will read a wide variety of creative nonfiction and narrative nonfiction books and articles, research a particular environmental issue in depth, and write their own original work of environmental narrative nonfiction (incorporating both their research and personal voice).
Semesters Offered:
Fall, 3 credits, Letter graded (A, A-, B+, etc.)

EHM 506: Topics in Sustainability and Study Abroad
This course offers students the opportunity to study abroad in a foreign setting and learn about another culture's approaches to environmental sustainability. The course will focus on one or more of the following subject areas: environmental creative writing, eco-aesthetics, renewable energy, environmental policy and design, environmental politics and history, environmental advocacy, permaculture, horticulture and landscape design. Participants will be assigned readings and research assignments prior to departure. Community service may be included. While traveling abroad, student will participate in lectures, readings, workshops, and site visits, and the course will culminate in a research capstone project.

3-6 credits, Letter graded (A, A-, B+, etc.)
May be repeated 1 times FOR credit.

EMP 501: Leadership
In this course, we review current and classic theories in leading and leading in diverse contexts. We examine leadership at different levels: leading groups and teams, leading projects, and leading complex organizations. We consider seminal questions in leadership studies including: What are the differences between managing and leading? How do leadership styles interact for effective leadership? How do leaders build community in their organizations? And we review several practical concerns of leadership, including leading change, leading in diverse contexts, and leader succession planning.

3 credits, Letter graded (A, A-, B+, etc.)
May be repeated 1 times FOR credit.

EMP 502: Engineering Economics
This course is a rapid introduction to the application of modern mathematical concepts and techniques in management science. Algebraic operations, mathematical functions and their graphical representation, and model formulation are reviewed. Topics covered include the following: algebraic and graphic methods of linear programming; PERT, CPM, and other network models; and inventory theory. Simple management-oriented examples are used to introduce mathematical formulations and extensions to more general problems. The computer laboratory may be
used to give students experience with PC software packages that solve problems in all course topics. Interpretation of computer outputs is also stressed. We will also discuss several quantitative methods for analyzing and controlling cost, lead time, and quality of the goods or services being produced.

3 credits, Letter graded (A, A-, B+, etc.)

**EMP 506: Strategic Technology Analysis**

This course is a rapid introduction to the application of modern mathematical concepts and techniques in management science and the foundation for an understanding of Operations Management principles for Engineers. Algebraic operations, mathematical functions and their graphical representation, and model formulation are reviewed. Topics and quantitative methods covered include the following: algebraic and graphic methods of linear programming; PERT, CPM, cost controls, Enterprise Resource Planning (ERP), lead-time, inventory, just-in-time systems, quality control and other network models for product goods or services as well as facility location and plant layout analysis, and project management. Simple management-oriented examples are used to introduce mathematical formulations and extensions to more general problems. The Value Chain process will be fully investigated and analyzed thru the; design, forecasting, supply chain, production and quality control stages. This is the process of creating company equity by transforming ideas and materials into true value-added, goods and services for stakeholders. Computer laboratories may be used to give students experience with PC software packages that solve problems in all course topics. The interpretation of computer outputs is also stressed.

3 credits, Letter graded (A, A-, B+, etc.)

**EMP 507: Research and Special Topics in Global Industrial Management**

An individual study course for students investigating special topics relating to global industrial management.

1-3 credits, Letter graded (A, A-, B+, etc.)

May be repeated 1 times FOR credit.

**EMP 509: Enterprise Information and Knowledge Systems Management**

This course covers the different types of enterprise systems, how they are used to manage an organization’s processes, re-engineering the business with enterprise systems, and the relationship among technology, organization, and management. Knowledge-based and web-based features in modern enterprise systems will be emphasized.

Database Management, Security, Control, Ethical, and Social issues of enterprise systems will be discussed.

Spring, 3 credits, Letter graded (A, A-, B+, etc.)

**EMP 511: Starting a Business Venture**

This course covers the necessities of beginning a business from turning a concept into a new venture and developing a business plan for a venture. Topics include how to identify and evaluate the product and its market potential; management and organization issues; production and channels of distribution; and how to present a plan to the financial community. Specific case studies and guest speakers are utilized.

Summer, 3 credits, Letter graded (A, A-, B+, etc.)

**EMP 517: Quality and Value Management**

Management’s approach to quality has changed radically; this course explains why and how. It covers methods used by both manufacturing and service organizations to achieve high quality: how each organizational function is involved in quality; how improving quality can reduce costs; importance of communication; importance of involving all employees; need to measure quality; and introduction to statistical quality control and how it is used.

3 credits, Letter graded (A, A-, B+, etc.)

**EMP 518: Project Management**

This is a course in project management. The objective is to give the student a fundamental understanding of what is required to plan organize and carry out projects in industry today. The student will also understand how management decisions are influenced by project and financial analysis when making project plans.

3 credits, Letter graded (A, A-, B+, etc.)

**EMP 521: Developing New Products**

This course covers how to manage enterprise innovation, corporate innovation cultures, ideation and creative thinking, product design and development processes and phases, issues in product design, collaboration between R&D and operations/marketing. Also, this class will focus on how to use forecasting to ensure the successful launch of a technology product. Case studies will be discussed.

3 credits, Letter graded (A, A-, B+, etc.)

**EMP 522: Strategic Marketing: Planning and Process**

This course will examine the vital role that strategic marketing and planning plays in all businesses, as well as non-profit and government organizations. Marketing's role in our economy, society and the appropriate marketing target and mix of media will also be presented. The various careers which exist in marketing and the structure of marketing plans and departments are studied. The class will create a marketing plan based on real products and present it.

3 credits, Letter graded (A, A-, B+, etc.)

**EMP 523: International Business and Management**

This course covers the world's marketplace, international environment, managing international business, and managing international business operations. Additional topics include cultural issues in a global marketplace, the impact of law and legal differences in the world marketplace compared to the U.S., and addressing competitive issues related to items such as a need for local contact.

3 credits, Letter graded (A, A-, B+, etc.)

**EMP 524: Modern Transportation Systems and Logistics**

The integration of the activities that procure materials and services, transform them into intermediate goods and final products, and deliver them to the customers in a global environment. This course covers all the logistical, ethics, and outsourcing issues in strategic and global ways.

3 credits, Letter graded (A, A-, B+, etc.)

**EMP 525: Technology Assessment for Emerging Technologies**

This course will address the technology assessment for emerging technology through four basic components of technology assessment: scope, technology, impact, and policy. Emerging technology will cover information technology, energy, and medical technology.

Offered Summer, 3 credits, Letter graded (A, A-, B+, etc.)

May be repeated for credit.

**EMP 530: Intro of Big Data & Data Science for Technological Management**

This course is an introduction to big data techniques, its applications and its challenges. We will analyze customer relationship management processes using software management tools such as DFD and UML and Lean & Six Sigma management to improve applications or services in a cloud computing environment. Data modeling, mining and visualization tools will be introduced for
developing business intelligence, predictive analytics and decision support applications. Technologies in related areas such as data warehousing, data sharing, data security, networking, and operating systems will also be included to support big data applications in cloud computing environments.

3 credits, Letter graded (A, A-, B+, etc.)

EMP 531: Data Mining for Technological Management
Data mining can be used to extract meaningful and actionable information from large data sets and then used for business intelligence, predictive analytics and decision support. Supervised and unsupervised machine learning techniques, such as linear regression, classification, decision trees, support vector machines, and clustering, will be discussed. These techniques and associated tools will be introduced in the context of customer relationship management (CRM), supply chain management (SCM), and global operations management applications. Semesters Offered: Fall, Spring, 3 credits, Letter graded (A, A-, B+, etc.)

EMP 532: Big Data Systems for Technology Management
Over the past two decades, the amount of data that is generated has grown exponentially and there is an increasing need to analyze all this data. This class will introduce students to the statistical software R, data analysis, text mining, and big data analyses.

3 credits, Letter graded (A, A-, B+, etc.)

EMP 572: Special Topics
This multidisciplinary course provides a comprehensive overview of emerging topics in society from both policy and technology point of view. Topics include energy, smart city, big data, disaster, bio-medical, and security. The goal of the course is to assist students to gain insights into different special topics to solve challenging problems and discover new ones. Offered Spring & Fall

3 credits, Letter graded (A, A-, B+, etc.)

ESE 501: System Specification and Modeling
A comprehensive introduction to the field of System-on-Chip design. Introduces basic concepts of digital system modeling and simulation methodologies. Various types of hardware description language (HDL) will be studied, including Verilog, VHDL, and SystemC. Topics include top-down and bottom-up design methodology, specification language syntax and semantics, RTL, behavioral and system-level modeling, and IP core development. Included are three projects on hardware modeling and simulation.

Fall, 3 credits, Letter graded (A, A-, B+, etc.)

ESE 502: Linear Systems

Fall, 3 credits, Letter graded (A, A-, B+, etc.)

ESE 503: Stochastic Systems

Fall, 3 credits, Letter graded (A, A-, B+, etc.)

ESE 504: Performance Evaluation of Communications and Computer Systems
Advanced scheduling theory, queuing models and algorithms for communication and computer systems. Transient analysis and M/G/1 queue models. Networks of queues, mean value analysis and convolution algorithms. Petri networks. Bursty and self-similar traffic. Divisible load theory for scheduling and parallel computer performance evaluation. Prerequisite: ESE 503 or permission of instructor.

3 credits, Letter graded (A, A-, B+, etc.)

ESE 505: Wireless Communications
This course covers first year graduate level material in the area of wireless communications: Wireless channels, overview of digital communications and signal processing for wireless comm., voice and data applications, design basics for wireless modems, analysis of system issues like resource management and handoff, cellular and wireless LAN systems.

Fall or Spring, 3 credits, Letter graded (A, A-, B+, etc.)

ESE 506: Wireless Network
This course will examine the area of wireless networking and mobile computing, looking at the unique network protocol challenges and opportunities presented by wireless communications and host or router mobility. The course will give a brief overview of fundamental concepts in mobile wireless systems and mobile computing, it will then cover system and standards issues including second generation circuit switched and third generation packet switched networks, wireless LANs, mobile IP, ad-hoc networks, sensor networks, as well as issues associated with small handheld portable devices and new applications that can exploit mobility and location information. This is followed by several topical studies around recent research publications in mobile computing and wireless networking field. This course will make the system architecture and applications accessible to the electrical engineer. Prerequisites: ESE 505 and ESE 546 or ESE 548, or permission of instructor.

3 credits, Letter graded (A, A-, B+, etc.)

ESE 507: Advanced Digital System Design and Generation
This course focuses on languages, tools and abstractions for design and implementation of digital systems. Course material is divided roughly into three categories: Limitations and constraints on modern digital systems; Hardware design abstractions, languages, and tools (including the SystemVerilog hardware description language); and new architectures and paradigms for digital design.
Coursework will be primarily project and assignment based; there will also be reading and discussion of published papers in these areas. Students should have experience with hardware description languages (VHDL, Verilog, or System Verilog) and software (C, C++ or Java).

Fall, 3 credits, Letter graded (A, A-, B+, etc.)

**ESE 509: Modern Energy Technologies**

This course covers a broad array of technologies that are essential to the modern energy industry, specifically focusing on the most contemporary topics and hot, areas of research, development, and deployment. Students will gain a quantitative understanding of selected energy generation technologies, energy storage technologies, and pollution control technologies.

3 credits, Letter graded (A, A-, B+, etc.)

**ESE 510: Electronic Circuits**

This is a course in the design and analysis of analog circuits, both discrete and integrated. The first part of the course presents basic topics related to circuit analysis: laws, theorems, circuit elements and transforms. Fundamental semiconductor devices are introduced next. A number of aspects of circuit design beginning with basic device operation through the design of large analog functional blocks including amplifiers, oscillators and filters are discussed. Cannot be used to fulfill any ESE degree requirements.

Fall, 3 credits, Letter graded (A, A-, B+, etc.)

**ESE 511: Solid-State Electronics**

A study of the electron and hole processes in solids leading to the analysis and design of solid-state electronic devices. Solutions to the Schrodinger representation of quantum effects, perturbation techniques. Simple band structure, effective mass theorem. Derivation and application of the Boltzmann transport theory. Electrical and thermal conductivities of metals and of semiconductors, and their application to electronic devices. Properties of semi conductors and the theories underlying the characteristics of semiconductor devices.

Fall, 3 credits, Letter graded (A, A-, B+, etc.)

**ESE 512: Introduction to Quantum Systems Engineering**

A study of fundamental properties of homojunction and heterojunction semiconductor devices. Derivation of the characteristic equation for p-n junction diodes, for the bipolar junction transistor (BJT) and for the heterojunction bipolar transistor (HBT); the device parameters for low- and high-frequency operation, the effects on the device characteristics of fabrication methods and of structural arrangements. The development of the large-signal and small-signal equivalent circuits for the p-n diode and the BJT and HPT devices, with emphasis on models used in prevalent computer-aided analysis (e.g., SPICE). Consideration of the devices in integrated-circuit applications.

Fall, 3 credits, Letter graded (A, A-, B+, etc.)

**ESE 513: Introduction to Photovoltaics**

Introduction to the basic concepts of photovoltaic solar energy conversion, including: 1. The solar resource in the context of global energy demand; 2. The operating principles and theoretical limits of photovoltaic devices; 3. Device fabrication, architecture, and primary challenges and practical limitations for the major technologies and materials used for photovoltaic devices. Students will gain knowledge of the device physics of solar cells, the operating principles of the major commercial photovoltaic technologies, the current challenges and primary areas of research within the field of photovoltaics, and a basic understanding of the role of photovoltaics in the context of the global energy system.

3 credits, Letter graded (A, A-, B+, etc.)

**ESE 514: MOSTransistor Modeling**

An overview of the metal-oxide semiconductor (MOS) transistor and its models for circuit analysis. The course is modular in structure. In a common first part, CMOS fabrication, device structure and operation are introduced. Starting from basic concepts of electrostatics, MOS field-effect transistor operation is presented in an intuitive fashion, and no advanced background in solid-state theory is required. Analytical models of increasing complexity and their SPICE Implementations are discussed. The second part of the course allows students to focus on their field of preference: Device physics; digital circuits; Analog circuits. The course includes a project in one of these subtopics.

Fall, 3 credits, Letter graded (A, A-, B+, etc.)

**ESE 515: Quantum Electronics I**

Physics of microwave and optical lasers. Topics include introduction to laser concepts; quantum theory; classical radiation theory; resonance phenomena in two-level systems; Block equations-Kramers-Kronig relation, density matrix; rate equation and amplification; CO2 lasers; discharge lasers; semiconductor lasers.

Fall, 3 credits, Letter graded (A, A-, B+, etc.)

**ESE 516: Integrated Electronic Devices and Circuits I**

Theory and applications: elements of semiconductor electronics, methods of fabrication, bipolar junction transistors, FET, MOS transistors, diodes, capacitors, and resistors. Design techniques for linear digital integrated electronic components and circuits. Discussion of computer-aided design, design, and LSI.

Fall, 3 credits, Letter graded (A, A-, B+, etc.)

**ESE 517: Integrated Electronic Devices and Circuits II**

Theory and applications: elements of semiconductor electronics, methods of fabrication, bipolar junction transistors, FET, MOS transistors, diodes, capacitors, and resistors. Design techniques for linear digital integrated electronic components and circuits. Discussion of computer-aided design, design, and LSI.

Spring, 3 credits, Letter graded (A, A-, B+, etc.)

**ESE 518: Advanced design of low noise and low power analog circuits**

Students will learn state-of-the-art circuit techniques for low-noise and low-power amplification and processing of signals from sensors. Examples of circuits are low-noise amplifiers, filters, peak director and discriminators. Applications range from medical, to security, safety, industrial measurements and physics research. As a course project, students will develop part of a front-end circuit from transistor level to physical layout using industry-standard CAD tools, and will participate in the experimental characterization of those similar circuits. At the end of the course the student will own a solid background and the basic instruments to design low-noise and low-power amplifiers and processing circuits.

Offered in Fall, 3 credits, Letter graded (A, A-, B+, etc.)

**ESE 519: Semiconductor Lasers and Photodetectors**

The course provides an introduction to performance, testing and fabrication techniques for semiconductor lasers and photodetectors. The topics include fundamentals of laser and detector operation, devices band diagram, device characteristics, and testing techniques for analog and digital edge emitting and surface emitting lasers, avalanche and PIN photodetectors. Special attention is given to the design and working characteristics of transmitters and pumping lasers for telecommunication networks.
ESE 520: Applied Electromagnetics
Spring, 3 credits, Letter graded (A, A-, B+, etc.)

ESE 522: Fiber Optic Systems
This course covers the essential components of a modern optical fiber communication system: (I) wave propagation in optical fiber waveguides, (II) transmitter design, (III) receiver design, (IV) single wavelength fiber-optic networks, and (V) wavelength division multiplexing networks.
Prerequisite: ESE 319
Fall, 3 credits, Letter graded (A, A-, B+, etc.)

ESE 523: Quantum Computing and Applications
This course is an introduction to and survey of the Quantum Computing, an emerging interdisciplinary field of science which has the potential to revolutionize computation over the next ten years, to transform chemistry, medicine, engineering and communications, as well as to change our understanding of physical world. The course will build intuitive approach to quantum computation and algorithms, but also will advance relevant vocabulary and skills for faculties and graduate students in engineering, computing, applied mathematics, chemistry, physics, and related sciences. The key questions of the quantum computing will be introduced. How to describe quantum systems and quantum operations? What is a quantum computer and what are the limits of quantum power? What is the difference between classical and quantum computation? Quantum teleportation? Quantum entanglement and superposition? How to mitigate errors and decoherence and transmit information through noisy channels? What are business applications and engineering challenges of the quantum computers? What are the gains in running quantum vs. classical algorithms? What are the physical principles of the current quantum computers hardware and what are technology requirements for realistic quantum computers?
4 credits, Letter graded (A, A-, B+, etc.)

ESE 524: Microwave Acoustics
Continuum acoustic field equations. Wave equation, boundary conditions, and Pointing vector. Waves in isotropic elastic media: plane-wave modes, reflection and refraction phenomena, bulk-acoustic-wave (BAW) waveguides, surface acoustic waves (SAW), Plane and guided waves in piezoelectric media. BAW transduction and applications: delay-line and resonator structures, the Mason equivalent circuit, monolithic crystal filters, IM CON dispersive delay lines, acoustic microscopes, SAW transduction and applications: the interdigital transducer, band-pass filters, dispersive filters, convolvers, tapped delay lines, resonators.
Prerequisite: ESE 319
Fall, 3 credits, Letter graded (A, A-, B+, etc.)

ESE 525: Modern Sensors in Artificial Intelligence Applications
Sensors are devices that convert physical values into electrical signals. This course will provide practical information on diversified subjects related to the operation principles, design and use of various sensors. Established and novel sensor technologies as well as problems of interfacing various sensors with electronics are discussed.
3 credits, Letter graded (A, A-, B+, etc.)

ESE 526: Silicon Technology for VLSI
This course introduces the basic technologies employed to fabricate advanced integrated circuits. These include epitaxy, diffusion, oxidation, chemical vapor deposition, ion implantation lithography and etching. The significance of the variation of these steps is discussed with respect to its effect on device performance. The electrical and geometric design rules are examined together with the integration of these fabrication techniques to reveal the relationship between circuit design and the fabrication process.
Fall, 3 credits, Letter graded (A, A-, B+, etc.)

ESE 528: Communication Systems
This course provides a general overview of communication theory and addresses fundamental concepts in this field. After a review of signals and systems representations, various continuous and digital modulation schemes are analyzed. Spread spectrum systems and their application to multiuser communications are also addressed. Advanced communication systems are described and general concepts of wide and local area networks are introduced.
Fall, 3 credits, Letter graded (A, A-, B+, etc.)

ESE 530: Computer-Aided Design
The course presents techniques for analyzing linear and nonlinear dynamic electronic circuits using the computer. Some of the topics covered include network graph theory, generalized nodal and hybrid analysis, companion modeling. Newton's method in n-dimensions and numerical integration.
Prerequisite: B.S. in Electrical Engineering
Spring, 3 credits, Letter graded (A, A-, B+, etc.)

ESE 531: Statistical Learning and Inference
Minimum variance unbiased estimation, Cramer- Rao lower bounds, learning and inference with linear models, maximum likelihood estimation, least squares estimation, Bayesian inference, statistical decision theory, hypothesis testing with deterministic and random signals, composite hypothesis testing, model selection.
3 credits, Letter graded (A, A-, B+, etc.)

ESE 532: Theory of Digital Communication
Optimum receivers, efficient signaling, comparison classes of signaling schemes. Channel capacity theorem, bounds on optimum system performance, encoding for error reduction, and the fading channel. Source coding and some coding algorithms. Prerequisite: ESE 503
Fall, 3 credits, Letter graded (A, A-, B+, etc.)

ESE 533: Convex Optimization and Engineering Applications
3 credits, Letter graded (A, A-, B+, etc.)

ESE 534: Cyber Physical Systems
As computers and communication bandwidth become ever-faster and ever-cheaper, computing and communication capabilities will be embedded in all types of objects and structures in the physical environment. Applications with enormous societal impact and economic benefit will be created by harnessing these capabilities in time and across space. We refer to systems that
bridge the cyber-world of computing and communications with the physical world as cyber physical systems (CPS). This course covers important areas from the research literature on SPS. Three application domains are emphasized: medical devices for health care, smart transportation systems, and smart buildings. Several key cross-cutting principles, independent of the application domain, are also covered, including formal modeling, embedded systems, real-time systems, feedback control and sensor networks. Prerequisite: Background in embedded systems and computer networking is necessary.

3 credits, Letter graded (A, A-, B+, etc.)

ESE 535: Power System Analysis
The course focuses on fundamental analytics of power systems. It will help students understand major problems in power system static, dynamic, and stability analysis, as well as fundamental optimization issues in power system operation. The course covers power system steady-state modeling with emphasis on admittance and impedance matrix, power system dynamics modeling with emphasis on the functional state-space model, power system analytics with emphasis on power flow analysis, eigenvalue analysis, and time-domain transient simulation, as well as fundamental power system operation issues with emphasis on optimal power flow, unit commitment, and power system control. Emphasis is on using applied mathematics and computer-based methods to analyze power system problems.

3 credits, Letter graded (A, A-, B+, etc.)

ESE 536: Switching and Routing in Parallel and Distributed Systems
This course covers various switching and routing issues in parallel and distributed systems. Topics include message switching techniques, design of interconnection networks, permutation, multicast and all-to-all routing in various networking nonblocking, and rearrangeable capability analysis and performance modeling.

3 credits, Letter graded (A, A-, B+, etc.)

ESE 537: Mobile Sensing Systems & Applications
This is a graduate course focusing on recent advances and developments in mobile sensing systems and their applications, especially those leveraging modern mobile devices and embedded sensors. Topics include: conventional mote-class sensor networks, participatory sensing leveraging mobile devices, intelligent hardware and Internet-of-Things, location sensing, future information centric networking, and applications in smart homes, buildings, transportation, environment and health/fitness. Student need to read latest literature and write reviews, work on research problems and develop solutions, present their work and write formal reports. The practice of the basic research skills are major components. This course intends to be self-sufficient and prior experiences in programming, mobile devices and embedded systems is a plus.

3 credits, Letter graded (A, A-, B+, etc.)

ESE 538: Nanoelectronics
The major goals and objectives are to provide graduate students with knowledge and understanding of physical background and applications of nanoelectronics. The course will cover electrical and optical properties of materials and nanostructures, fabrication of nanostructures, nanoelectronic devices including resonant-tunneling devices, transistors, and single-electron transfer devices, as well as applications of nanotechnologies in molecular biology and medicine.

3 credits, Letter graded (A, A-, B+, etc.)

ESE 539: Power Electronics and Motor Drives
This course is designed to cover the basic concepts of motor control, motor drive design and power electronics inverters.

3 credits, Letter graded (A, A-, B+, etc.)

ESE 540: Reliability Theory
Theory of reliability engineering. Mathematical and statistical means of evaluating the reliability of systems of components. Analytical models for systems analysis, lifetime distributions, repairable systems, warranties, preventive maintenance, and inspection. Software reliability and fault tolerant computer systems. Prerequisite: ESE 503 or permission of instructor

3 credits, Letter graded (A, A-, B+, etc.)

ESE 541: Digital System Design
The course provides an introduction to digital and computer systems. The course follows a top-down approach to presenting design of computer systems, from the architectural-level to the gate-level. VHDL language is used to illustrate the discussed issues. Topics include design hierarchy and top-down design, introduction to hardware description languages, computer-aided design and digital synthesis, basic building blocks like adders, comparators, multipliers, latches, flip-flops, registers etc, static and dynamic random access memory, data and control buses, fundamental techniques for combinational circuit analysis and design, sequential circuit design procedures, and programmable logic devices. Testing of digital designs is addressed throughout the course. A mini project will complement the course.

Cannot be used to fulfill any ESE degree requirements.

Spring, 3 credits, Letter graded (A, A-, B+, etc.)

ESE 542: Product Design Concept Development and Optimization
This graduate course will concentrate on the design concept development of the product development cycle, from the creative phase of solution development to preliminary concept evaluation and selection. The course will then cover methods for mathematical modeling, computer simulation and optimization. The concept development component of the course will also cover intellectual property and patent issues. The course will not concentrate on the development of any particular class of products, but the focus will be mainly on mechanical and electromechanical devices and systems. As part of the course, each participant will select an appropriate project to practice the application of the material covered in the course and prepare a final report.

Prerequisites: Undergraduate electrical or mechanical engineering and/or science training.

Fall, 3 credits, Letter graded (A, A-, B+, etc.)

ESE 543: Mobile Cloud Computing
Introduction to the basic concepts of mobile cloud computing, including 1. The mobile computing technology used in modern smart phones; 2. The cloud computing technologies used in existing data centers; 3. The synergy of mobile and cloud computing and its applications; and 4. Programming on smart phone utilizing data center services. Students will gain knowledge of the fundamental principles of mobile cloud computing, the major technologies that support mobile cloud computing, the current challenges and primary areas of research within the field of mobile cloud computing, and a basic understanding of the role of mobile cloud computing in the context of the everyday living.

3 credits, Letter graded (A, A-, B+, etc.)

ESE 544: Network Security Engineering
An introduction to computer network and telecommunication network security engineering. Special emphasis on building security into hardware and hardware working with software. Topics include encryption, public key cryptography, authentication,
intrusion detection, digital rights management, firewalls, trusted computing, encrypted computing, intruders and virus. Some projects.

**Fall, alternate years, 3 credits, Letter graded (A, A-, B+, etc.)**

**ESE 545: Computer Architecture**

The course covers uniprocessor and pipelined vector processors. Topics include: hierarchical organization of a computer system; processor design; control design; memory organization and virtual memory; I/O systems; balancing subsystem bandwidths; RISC processors; principles of designing pipelined processors; vector processing on pipelines; examples of pipelined processors. The course involves a system design project using VHDL.

**Prerequisite: ESE 218 or equivalent**

**ESE 546: Networking Algorithms and Analysis**

An introduction to algorithms and analysis for computer and telecommunication networks. Continuous time and discrete time single queue analysis. Algorithms from public key cryptography, routing, protocol verification, multiple access, error codes, data compression, search.

**Prerequisite: ESE 503 or permission of instructor:**

**Fall, 3 credits, Letter graded (A, A-, B+, etc.)**

**ESE 547: Digital Signal Processing**


**Prerequisite: Senior level course in signals and systems**

**Fall, 3 credits, Letter graded (A, A-, B+, etc.)**

**ESE 548: Computer Networks**

Basic theory and technology of computer communications. Introduction to performance evaluation, error codes and routing algorithms. Other topics include Ethernet, wireless networks including LTE and 5G, fiber optic networking, software defined networking, networking on chips, space networks, data centers, grids and clouds, and network security. 3 credits, grading ABCF.

**3 credits, Letter graded (A, A-, B+, etc.)**

**ESE 549: Advanced VLSI System Testing**

This course is designed to acquaint students with fault diagnosis of logic circuits. Both combinatorial and sequential circuits are considered. Concepts of faults and fault models are presented. Emphasis is given to test generation, test selection, fault detection, fault location, fault location within a module and fault correction.

**Prerequisite: ESE 505 or equivalent**

**Fall, 3 credits, Letter graded (A, A-, B+, etc.)**

**ESE 550: Network Management and Planning**

This course provides an introduction to telecommunications and computer network management and planning. Network management is concerned with the operation of networks while network planning is concerned with the proper evolution of network installations over time. Network management topics include meeting service requirements, management operations, management interoperability, and specific architectures such as Telecommunications Management Network (TMN), and Simple Network Management Protocol (SNMP). Network planning topics include planning problem modeling, topological planning design, heuristic and formal solution techniques.

**Fall, 3 credits, Letter graded (A, A-, B+, etc.)**

**ESE 551: Electronics and Radiation Effects**

A study of the effects of radiation on electronic circuit operation. Radiation may come from space or man-made sources such as nuclear reactors or CAT scan machines. Coverage includes types of radiation, types of effects on circuits such as SEE (Single Event Effects), designing circuits to mitigate radiation effects and testing of circuits prior to deployment. Applications include electronics for space and for use in nuclear reactors and certain medical imaging machines.

**Spring, 3 credits, Letter graded (A, A-, B+, etc.)**

**ESE 552: Interconnection Networks**

Formation and analysis of interconnect processing elements in parallel computing organization. Topics include: SIMD/MIMD computers, multiprocessors, multicomputers, density, symmetry, representations, and routing algorithms. Topologies being discussed include: Benes, Omega, Banyan, mesh, hypercube, cube-connected cycles, generalized chordal rings, chordal rings, DeBruijn, Moebius graphs, Cayley graphs, and Borel Cayley graphs.

**Prerequisite: ESE 545 or equivalent**

**Fall, 3 credits, Letter graded (A, A-, B+, etc.)**

**ESE 553: A/D and D/A Integrated Data Converters**

This is an advanced course on analog integrated circuit design aspects for data converters. Topics include: continuous and discrete-time signals and systems; sampling theorems; ideal ND and D/A converters; specifications and testing of data converters; basic building blocks in data converters: current sources and mirrors, differential gain stages, voltage references, S/H circuits, comparators: Nyquist D/A and ND converters: principles of data conversion and circuit design techniques; oversampling data converters: low-pass and band-pass delta-sigma modulators, decimation and interpolation for delta-sigma data converters. The attending students must be acquainted with principles of transistor operation, function of simple analysis. Familiarity with SPICE is required.

**3 credits, Letter graded (A, A-, B+, etc.)**

**ESE 554: Computational Models for Computer Engineers**

This course covers mathematical techniques and models used in the solution of computer engineering problems. The course heavily emphasizes computer engineering application. Topics covered include set theory, relations, functions, graph theory and graph algorithms, and algebraic structures.

**Fall, 3 credits, Letter graded (A, A-, B+, etc.)**

**ESE 555: Advanced VLSI Systems Design**

Techniques of VLSI circuit design in the MOS technology are presented. Topics include MOS transistor theory, CMOS processing technology, MOS digital circuit analysis and design, and various CMOS circuit design techniques. Digital systems are designed and simulated throughout the course using an assortment of VLSI design tools.

**Prerequisite: B.S. in Electrical Engineering or Computer Science**

**Spring, 3 credits, Letter graded (A, A-, B+, etc.)**

**ESE 556: VLSI Physical and Logic Design Automation**

Areas to be covered are Physical Design Automation and Logic Design Automation. Upon completion of this course, students will be able to develop state-of-the art CAD tools and algorithms for VLSI logic and physical design. Tools will address design tasks such as floor planning, module placement and signal routing. Also, automated optimization of...
combinational and sequential circuits will be contemplated.

Prerequisite: B.S. in Computer Engineering/Science or Electrical Engineering

Fall, 3 credits, Letter graded (A, A-, B+, etc.)

ESE 557: Digital Signal Processing II: Advanced Topics

A number of different topics in digital signal processing will be covered, depending on class and current research interest. Areas to be covered include the following: parametric signal modeling, spectral estimation, multirate processing, advanced FFT and convolution algorithms, adaptive signal processing, multidimensional signal processing, advanced filter design, dedicated signal processing chips, and signal processing for inverse problems. Students will be expected to read and present current research literature.

Prerequisite: ESE 547 or permission of instructor

Spring, 3 credits, Letter graded (A, A-, B+, etc.)

ESE 558: Digital Image Processing I

Covers digital image fundamentals, mathematical preliminaries of two-dimensional systems, image transforms, human perception, color basics, sampling and quantization, compression techniques, image enhancement, image restoration, image reconstruction from projections, and binary image processing.

Prerequisite: B.S. in Engineering or Physical or Mathematical Sciences

Fall, 3 credits, Letter graded (A, A-, B+, etc.)

ESE 559: EMI in Power Electronics Converters: Generation, Propagation and Mitigation

This course is designed to cover the basic concepts of electro-magnetic-interference issues in power electronics converters. The course materials will cover basic concepts of EMI measurement, modeling and mitigation, with the focus on conducted EMI in power electronics converters. The course is structured with lectures and a lab session. This course is offered to both senior undergraduate and graduate students. Students cannot get credit for both undergraduate level and graduate level. Undergraduate and graduate students will take exams and quizzes at the same time but with different designed questions.

3 credits, Letter graded (A, A-, B+, etc.)

May be repeated 1 times FOR credit.

ESE 561: Theory of Artificial Intelligence

Problem solving by searching, game trees, constraint satisfaction problems, uncertain knowledge and reasoning, probabilistic reasoning, probabilistic reasoning over time, Markov decision processes, partially observable Markov decision processes, reinforcement learning, generalized reinforcement learning.

3 credits, Letter graded (A, A-, B+, etc.)

ESE 562: AI Driven Smart Grids

The course focuses on Artificial Intelligence (AI) applications to power system analysis, planning and operation. Topics include basics of AI and smart grid, data preprocessing, predictive analytics, AI driven static analytics, such as optimal dispatch, state estimation and security assessment, and AI-based dynamical analytics such as transient stability assessment, dynamic model discovery and emergency control. Emerging topics, including transfer learning, data-driven formal methods, learning-based cybersecurity and big data platform, are also discussed. Prerequisite: An undergraduate course in power systems

3 credits, Letter graded (A, A-, B+, etc.)

ESE 563: Fundamentals of Robotics I

This course covers homogenous transformations of coordinates; kinematic and dynamic equations of robots with their associated solutions; control and programming of robots.

Prerequisite: Permission of instructor

Fall, 3 credits, Letter graded (A, A-, B+, etc.)

ESE 564: Artificial Intelligence for Robotics

Artificial Intelligence is intelligence demonstrated by machines, unlike the natural intelligence displayed by humans and animals. Research and AI focuses on the development and analysis of algorithms that learn and perform intelligent behavior with minimal human intervention. This course aims to introduce students some basic techniques and algorithms in AI including probabilistic inference, planning and search, localization, tracking and control, and their applications to robotics.

3 credits, Letter graded (A, A-, B+, etc.)

May be repeated for credit.

ESE 565: Parallel Processing Architectures

This course provides a comprehensive introduction to parallel processing. Topics include types of parallelism, classification of parallel computers, functional organizations, interconnection networks, memory organizations, control methods, parallel programming, parallel algorithms, performance enhancement techniques and design examples for SIMD array processors, loosely coupled multiprocessors, and tightly coupled multiprocessors. A brief overview of dataflow and reduction machines will also be given.

Prerequisite: ESE 545 or equivalent

Spring, 3 credits, Letter graded (A, A-, B+, etc.)

ESE 566: Hardware-Software Co-Design of Embedded Systems

This course will present state-of-the-art concepts and techniques for design of embedded systems consisting of hardware and software components. Discussed topics include system specification, architectures for embedded systems, performance modeling and evaluation, system synthesis and validation. The course is complemented by three mini-projects focused on designing and implementing various co-design methods. Prerequisite: ESE 545, ESE 554 and ESE 333

Fall

3 credits, Letter graded (A, A-, B+, etc.)

ESE 568: Computer and Robot Vision

Principles and applications of computer and robot vision are covered. Primary emphasis is on techniques and algorithms for 3D machine vision. The topics include image sensing of 3D scenes, a review of 2D techniques, image segmentation, stereo vision, optical flow, time-varying image analysis, shape from shading, texture, depth from defocus, matching, object recognition, shape representation, interpretation of line drawings, and representation and analysis of 3D range data. The course includes programming projects on industrial applications of robot vision.

3 credits, Letter graded (A, A-, B+, etc.)

ESE 569: Translational Bioinformatics

Advanced technologies have driven rapid increases in the quantities of biomedical data. Translational bioinformatics develops the specified computational and analytic methods to transform these large-scale datasets into biomedical applicable information and knowledge. It is one of major applications of machine learning and data mining. This course introduces large-scale biomedical data resources and management, data processing and modeling, data mining and machine learning approaches in translational bioinformatics, and provides the hands-on projects for students to practice these approaches for real-world biomedical data.

3 credits, Letter graded (A, A-, B+, etc.)

ESE 575: Advanced VLSI Signal Processing Architecture
This course is concerned with advanced aspects of VLSI architecture in digital signal processing and wireless communications. The first phase of the course covers the derivation of both data transformation and control sequencing from a behavioral description of an algorithm. The next phase reviews the general purpose and dedicated processor for signal processing algorithms. This course focuses on low-complexity high-performance algorithm development and evaluation, system architecture modeling, power-performance tradeoff analysis. The emphasis is on the development of application-specific VLSI architectures for current and future generation of wireless digital communication systems. An experimental/research project is required.

3 credits, Letter graded (A, A-, B+, etc.)

**ESE 574: Power System Dynamics**
The course provides the background for understanding power system dynamics and numerical simulation techniques. Topics include the numerical integration for large-scale power networks, numerical oscillation and its solution, power system component modeling, frequency-dependent transmission network, nonlinear elements, network equivalents, power network stability, and microgrid stability & control. The area of real-time simulation for cyber-physical power infrastructures will also be discussed.

3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

**ESE 575: Deep Learning Algorithms and Software**
This course is an introduction to deep learning which uses neural networks to extract layered high-level representations of data in a way that maximizes performance on a given task. Deep learning is behind many recent advances in AI, including Siri’s speech recognition, Facebook’s tag suggestions and self-driving cars. Topics covered include basic neural networks, convolutional and recurrent network structures, deep unsupervised and reinforcement learning, and applications to problem domains like speech recognition and computer vision. Classes will be a mix of short lectures and tutorials, hands-on problem solving, and project work in groups.

3 credits, Letter graded (A, A-, B+, etc.)

**ESE 576: Quantum-Engineered Power Grids**
The course focuses on the applications of quantum information science (QIS) to power system analysis, operation and communication. Topics will cover basics of QIS and smart grid, quantum computing, quantum circuits, quantum-enabled power grid steady-state/ transient/stochastic analysis, application of quantum optimization and quantum machine learning in power grids, quantum control, quantum security, quantum Internet. Emphasis of the course is the practical quantum algorithms in power system applications and hands-on experiments on IBM Quantum platform.

3 credits, Letter graded (A, A-, B+, etc.)

**ESE 579: Advances Topics in Translational Bioinformatics**
This course introduces the current applications of machine learning and data mining techniques in biomedical data science, discusses the latest translational research areas and progresses, and provides the hands-on team projects for graduate students to explore, design and practice their data-driven solutions for the cutting-edge research topics in biomedical data science.

3 credits, Letter graded (A, A-, B+, etc.)

**ESE 581: Microprocessor-Based Systems Engineering II**
This course is a study of methodologies and techniques for the engineering design of microprocessor-based systems. Emphasis is placed on the design of reliable industrial quality systems. Diagnostic features are included in these designs. Steps in the design cycle are considered. Specifically, requirement definitions, systematic design implementation, testing, debugging, documentation, and maintenance are covered. Laboratory demonstrations of design techniques are included in this course. The students also obtain laboratory experience in the use of microprocessors, the development of systems, circuit emulation, and the use of signature and logic analyzers.

Spring, 4 credits, Letter graded (A, A-, B+, etc.)

**ESE 585: Nanoscale Integrated Circuit Design**
This course describes high performance and low power integrated circuit (IC) design issues for advanced nanoscale technologies. After a brief review of VLSI design methodologies and current IC trends, fundamental challenges related to the conventional CMOS technologies are described. The shift from logic-centric to interconnect-centric design is emphasized. Primary aspects of an interconnect-centric design flow are described in four phases: (1) general characteristics of on-chip interconnects, (2) on-chip interconnects for data signals, (3) on-chip power generation and distribution, and (4) on-chip clock generation and distribution. Existing design challenges faced by IC industry are investigated for each phase. Tradeoffs among various design criteria such as speed-power-noise-area are highlighted. In the last phase of the course, several post-CMOS devices, emerging circuit styles, and architectures are briefly discussed. At the end of the course, the students will have a thorough understanding of the primary circuit and physical level design challenges with application to industrial IC design.
Prerequisites: ESE 555 or ESE 330 and ESE 355

Spring, 3 credits, Letter graded (A, A-, B+, etc.)

**ESE 586: Micro Grids**
This course will discuss techniques useful for the grid modernization from a unique angle of microgrid design, analysis and operation. It will cover smart inverters, microgrid architectures, distributed energy resources modeling, microgrid hierarchical control, microgrid stability, fault management, resilient microgrids through programmable network, reliable networked microgrids, and cyber security.

3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

**ESE 587: Hardware Architectures for Deep Learning**
This course focuses on the design and implementation of specialized digital hardware systems for executing deep learning algorithms. The course is divided into three sections. First, students will study field-programmable gate arrays (FPGAs) and related tools. Second, the course will present an overview of modern deep learning algorithms and applications (e.g., visual object recognition, or speech recognition). Third, students will apply this knowledge to complete a significant design project implementing and optimizing a deep learning algorithm on an FPGA.

3 credits, Letter graded (A, A-, B+, etc.)

**ESE 588: Fundamentals of Machine Learning**
The fundamentals of machine learning are introduced including learning with parametric models, online learning; stochastic gradient descent family of methods; classification; logistic regression; the naïve Bayes classifier; the nearest neighbor rule; classification trees; boosting methods; sparsity aware learning; concepts and methods; learning in reproducing kernel Hilbert spaces; Bayesian learning; variational approximation, sparse Bayesian learning, relevance vector machines; neural networks and deep learning; the backpropagation algorithm; convolutional
neural networks; recurrent neural networks; adversarial training; dimensionality reduction; PCA; ICA; nonlinear dimensionality reduction. Prerequisite: Stochastic processes or permission by instructor

**ESE 589: Learning Systems for Engineering Applications**
The course presents the main methods used in automated (machine) learning for engineering applications. The course discusses representation models for learning, extraction of frequent patterns, classification, clustering and application of these techniques for diverse engineering applications, such as Intranet-of-Things, electronic design automation, and healthcare. The covered topics include an overview of learning systems, learning representations i.e. ontologies, regression models, stochastic models and symbolic models, data preparing techniques, different frequent pattern extraction methods, supervised and unsupervised classification, and basic and advanced clustering algorithms. The course is organized as three modules, each module being centered on a specific theme. Students will learn the characteristics of the enumerated topics, and devise and implement software programs for discussed techniques as part of their project work for the course. Student projects will be assessed using standard benchmarks.

*3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.*

**ESE 590: Practical Machine Learning and Artificial Intelligence**
The course provides a broad introduction to the state-of-the-art of machine learning methods through lectures and labs, where the lectured summarize the theoretical foundations of the methods. Students work in teams and utilize modern tools to develop a specific application in areas like computer vision, biomedical engineering and social sciences.

*3 credits, Letter graded (A, A-, B+, etc.)*

**ESE 591: Industrial Project in OEMS Engineering**
A student carries out a detailed design of an industrial project in OEMS engineering. A comprehensive technical report of the project and an oral presentation are required.

*Fall, 3 credits, Letter graded (A, A-, B+, etc.)*

**ESE 592: Distributed Computation, Control and Learning Over Networks**
Network Science is an interdisciplinary research area, which typically deals with large-scale complex networks. This course covers fundamental problems in distributed computation and control, including consensus and distributed averaging, distributed optimization, discusses the rendezvous problem and formation control, and explores recent development in distributed machine learning over networks.

*3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.*

**ESE 593: High Power RF Engineering**
The course starts with an essential review of the properties of low and medium power RF waves and components including transmission lines, waveguides and cavities, and then proceeds to highlight the properties and limitations under high power RF conditions. The principal deleterious effects taking place at high power levels are caused by arcing (a high peak power effect) and the ohmic dissipation in the metal walls (a high average power effect). Exceeding the power handling capacity of the RF components can result in expensive repairs. Methods of mitigating or avoiding these expensive repairs are discussed. Important applications of high power RF are discussed in depth. Finally the students are given an extended project on implementing a particle accelerator using the traditional method of placing cylindrical cavities in tandem and using the longitudinal electric field in the TM010 cavity mode to pump RF power into a particle beam and cause the desired acceleration of the charge particles.

*1-3 credits, Letter graded (A, A-, B+, etc.)*

**ESE 597: Practicum in Engineering Internship**
This course is for part-time and full-time graduate students, relating to their current professional activity. Participation is in private corporations, public agencies or non-profit institutions. Students will be required to have a faculty advisor as well as a contact in the outside organization to participate with them in regular consultations on their project. Students are required to submit a final written final report to both.

*The maximum credits which can be accepted towards the M.S. degree is 3 credits.*

*Fall, Spring, Summer, 1-3 credits, S/U grading
May be repeated for credit.*

**ESE 599: Research Master's students**
Fall and Spring, 1-12 credits, S/U grading

*May be repeated for credit.*

**ESE 610: Seminar in Solid-State Electronics**
Current research in solid-state devices and circuits and computer-aided network design.

*Fall and Spring, 3 credits, Letter graded (A, A-, B+, etc.)*

**ESE 670: Topics in Electrical Sciences**
Varying topics selected from current research topics. This course is designed to give the necessary flexibility to students and faculty to introduce new material into the curriculum before it has attracted sufficient interest to be made part of the regular course material. Topics include biomedical engineering, circuit theory, controls, electronics circuits, digital systems and electronics, switching theory and sequential machines, digital signal processing, digital communications, computer architecture, networks, systems theory, solid-state electronics, integrated electronics, quantum electronics and lasers, communication theory, wave propagation, integrated optics, optical communications and information processing, instrumentation, and VLSI computer design and processing.

*Fall and Spring, 3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.*

**ESE 691: Seminar in Electrical Engineering**
This course is designed to expose students to the broadest possible range of the current activities in electrical engineering. Speakers from both on and off campus discuss topics of current interest in electrical engineering.

*Fall and Spring, 1 credit, S/U grading
May be repeated for credit.*

**ESE 697: Ph.D. Practicum in Teaching**
The course provides hands-on experience in classroom teaching. Other activities may include preparation and supervision of laboratory experiments, exams, homework assignments and projects. Final report that summarizes the activities and provides a description of the gained experience and a list of recommendations is required. Prerequisite: G5 status and Permission of Graduate Program Director

*3 credits, Letter graded (A, A-, B+, etc.)*

**ESE 698: Practicum in Teaching**
This course enables graduate students to gain experience in teaching and interacting with students enrolled in an electrical and computer engineering course. Students enrolled in ESE-698 are expected to perform various teaching duties required by the course instructor, such as attending lectures, providing office hours, holding review/recitation
sessions, assisting in lab sections and grading, etc.
Fall, Spring, Summer, 1-3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

**ESE 699: Dissertation Research on Campus**
Prerequisite: Advancement to candidacy (G5). Major portion of research must take place on SBU campus, at Cold Spring Harbor, or at the Brookhaven National Lab.
Fall, Spring, and Summer, 1-9 credits, S/U grading
May be repeated for credit.

**ESE 700: Dissertation Research off Campus - Domestic**
Prerequisite: Must be advanced to candidacy (G5). Major portion of research will take place off-campus, but in the United States and/or U.S. provinces. Please note, Brookhaven National Labs and the Cold Spring Harbor Lab are considered on-campus. All international students must enroll in one of the graduate student insurance plans and should be advised by an International Advisor.
Fall, Spring, 1-9 credits, S/U grading
May be repeated for credit.

**ESE 701: Dissertation Research off Campus - International**
Prerequisite: Must be advanced to candidacy (G5). Major portion of research will take place outside of the United States and/or U.S. provinces. Domestic students have the option of the health plan and may also enroll in MEDEX. International students who are in their home country are not covered by mandatory health plan and must contact the Insurance Office for the insurance charge to be removed. International students who are not in their home country are charged for the mandatory health insurance. If they are to be covered by another insurance plan they must file a waiver be second week of classes. The charge will only be removed if other plan is deemed comparable.
All international students must received clearance from an International Advisor.
Fall, Spring, 1-9 credits, S/U grading
May be repeated for credit.

**ESE 800: FULL TIME SUMMER RESEARCH**
May be repeated for credit.

**ESL**

**ESL 593: Advanced Composition**
Advanced training in writing for ESL students who need to concentrate on paragraph development. The first half of the semester deals with paragraph construction, stressing concepts of the main thesis and supporting arguments. Some advanced grammar is reviewed, but the assumption is that basic structures and mechanics of writing have already been mastered. The second half of the semester stresses combining paragraphs into short compositions. Both descriptive and argumentative writing are practiced. Diagnostic test during first week of classes determines placement in the course. A through C/Unsatisfactory grading only.
3 credits, Letter graded (A, A-, B+, etc.)

**ESM**

**Materials Science**

**ESM 501: Teaching and Mentoring Techniques**
Discussion of various phases of teaching, including preparation, classroom technique, and student evaluation. Also exploration of skills and understanding necessary for mentoring of undergraduates and others involved in research.
Fall, 1 credit, S/U grading

**ESM 502: Scanning Electron Microscopy Skills**
Practical introduction to the operation of scanning electron microscopes, including energy-dispersive X-ray spectrometers. Required of all students who use the SEM in their research.
Spring, 1 credit, Letter graded (A, A-, B+, etc.)

**ESM 503: Electron Diffraction**
A quantitative discussion of electron diffraction as a means of micro-characterization of materials and as a basis for understanding image contrast in the transmission electron microscope. Topics covered include atomic, kinematical, and dynamical scanning; indexing diffraction patterns; and convergent-beam diffraction.
Spring, 3 credits, Letter graded (A, A-, B+, etc.)

**ESM 508: Impact of Materials on Environment**
This course will focus on several concepts underlying the impact of materials on the environment and various methods of minimizing them. More specifically this course will explore the concepts of air and water pollution associated with product manufacturing, various concepts of hazardous materials impact on human health, several topics of sustainable developments and selected methods of contaminated water and air treatment. Additionally this course will be addressing the issues of how to minimize the environmental pollution by product substitution and by decreasing the energy input into materials production. It will also give an overview of the concepts of green chemistry, green engineering and industrial ecology.
Offered in Spring, 3 credits, Letter graded (A, A-, B+, etc.)

**ESM 511: Thermodynamics of Solids**
Current knowledge regarding the thermodynamic properties of condensed phases is discussed. The thermodynamic treatment of ideal, regular, and real solutions is reviewed. Estimation of reaction-free energies and equilibria in condensed phase reactions such as diffusion, exication, and phase transformations; thermodynamic analysis of phase equilibrium diagrams.
Fall, 3 credits, Letter graded (A, A-, B+, etc.)

**ESM 512: Structure of Materials**
The structure of solids can be studied using X-ray, neutron, and electron diffraction techniques. Topics covered are coherent and incoherent scattering of radiation, structure of crystalline and amorphous solids, stereographic projection and crystal orientation determination, the concept of reciprocal vector space. Laboratory work in X-ray diffraction is also included.
Fall, 3 credits, Letter graded (A, A-, B+, etc.)

**ESM 513: Strength of Materials**
A unified approach for all solid materials will be used with regard to the correlation between microstructure and their macroscopic mechanical properties. The course deals with various testing techniques for delineating mechanical properties of materials, considering elasticity, inelasticity, plasticity, dislocation theory, cohesive strength, fracture, and surface wear. Attention is given to strengthening mechanisms for solids, metals, ceramics, and polymers.
Fall, 3 credits, Letter graded (A, A-, B+, etc.)

**ESM 514: Technical Writing for Materials Scientists**
Students will examine writing as it appears in published and draft format, taking into account different audience needs. Processes we will cover include: planning, organizing, writing, review, editing and rewriting. Grammar issues, particularly those that challenge non-native
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speakers, will also be addressed. We will be working with Professor Gerald Graff’s idea of “They Say/I Say,” a cornerstone strategy of academic conversation, in which newer colleagues in a field (i.e., undergraduate and graduate students) learn by apprenticeship how to engage their peers in the discussion of ideas through written format. Offered

Spring, 0-3 credits, S/U grading

ESM 519: Electrochemistry and Electrochemical Materials Science
This course will survey electrochemistry and electrochemical materials science. Topics will include fundamental measurements in electrochemistry, galvanostatic and potentiostatic methods, the electrochemical double layer, corrosion and passivation. Relevant applications such as fuel cells, batteries, and supercapacitors will be discussed.

3 credits, Letter graded (A, A-, B+, etc.)

ESM 521: Kinetics of Materials
This course will survey important kinetic phenomena in materials science and engineering. The studies of kinetics explore how materials evolve and change in structure, morphology and composition. The understanding of kinetics in materials leads to a broad impact in all scientific and engineering fields concerning materials design and processing. This course will cover topics ranging from core concepts such as various diffusion phenomena and motions of defects and interfaces, to more complex subjects such as phase transformations and development of microstructure. It emphasizes the comprehension of fundamentals, leading to a better understanding of processing-structure-property relationships.

3 credits, Letter graded (A, A-, B+, etc.)

ESM 522: Imperfections in Crystals
The characteristics of point defects in metals, semiconductors, and ionic solids are described, and the thermodynamics of point defects is developed. Dislocation theory is introduced and the structures of internal boundaries are described. Finally, interactions between lattice imperfections are discussed, with emphasis on plasticity and fracture.

Spring, 3 credits, Letter graded (A, A-, B+, etc.)

ESM 523: Solid-State Electronics
A study of the electronic processes in solids leading to the analysis and design of materials and devices. Crystal structures, binding, electrical and thermal conductivities, diffusion, galvomagnetic, thermomagnetic, and thermoelectric effects. Hall effect and magnetoresistance. Conductivity in thin films.

Fall, 3 credits, Letter graded (A, A-, B+, etc.)

ESM 531: Phase Transformations
Kinetics and Transformations II changed to Phase Transformations. A review of the processes by which structures are changed in the solid state. Classical nucleation theory including homogeneous and heterogeneous mechanisms. Diffusion and diffusionless growth mechanisms. Transformation kinetics.

Spring, 3 credits, Letter graded (A, A-, B+, etc.)

ESM 532: Materials Processing
A study of processing manufacturing processes used in the semiconductor industries. Topics include single crystal growth, compound formation, zone refining, epitaxial growth, doping techniques, thin film techniques, thick film techniques, passivations, isolations, lead bonding techniques, cleaning and etching, and failure analysis; discrete devices and integrated circuit devices; various modern concepts in IC processing.

Fall, 3 credits, Letter graded (A, A-, B+, etc.)

ESM 533: Polymeric Materials
This course will cover topics ranging from core concepts such as various diffusion phenomena and motions of defects and interfaces, to more complex subjects such as phase transformations and development of microstructure. It emphasizes the comprehension of fundamentals, leading to a better understanding of processing-structure-property relationships.

3 credits, Letter graded (A, A-, B+, etc.)

ESM 534: Advanced Laboratory
Students perform a series of advanced materials experiments which involve some independent research. The results are then written in a report suitable for publication in a journal or proceeding.

Fall, 3 credits, Letter graded (A, A-, B+, etc.)

ESM 537: Cellular Interactions
This course is intended to introduce cellular and biological concepts and principles for graduate students in chemical engineers related to their research projects that involve cellular interactions with materials as possible scaffolds in bioengineering. This course may be counted as either CSE 370 or ESM 537.

Spring, 3 credits, Letter graded (A, A-, B+, etc.)

ESM 542: Modern Electron Microscopy

Fall, 3 credits, Letter graded (A, A-, B+, etc.)

ESM 550: Introduction to Homeland Security
The course is a combination of lectures and laboratory experience to introduce students to critical issues and assess needs for homeland security. The course includes invited lectures by experts on special topics such as fundamentals of nuclear, chemical, and biological weapons and the associated threat to the transportation of goods and the public. The students will learn about cyber security, devices to safeguard materials from terrorist threats, safety of nuclear power plants and water supply, forensics and emergency preparedness. The students will submit a term paper on a selected topic in lieu of the final exam.

Prerequisite: undergraduate level biology, chemistry and physics.

Fall, Spring, 3 credits, Letter graded (A, A-, B+, etc.)

ESM 553: Nuclear Safeguards and Security
The course is intended to familiarize students with the fundamentals of nuclear physics, radiation, mining, weapons and fuel cycle, other than producing electricity, as it pertains to nuclear power plants. Topics include nuclear detection, devices to safeguard nuclear materials from terrorist threats, needed physical protection for safe handling and its relevance to Homeland Security. The course includes lectures with hands-on experience at the newly installed nuclear detection facility located at the nearby United States Department of Energy’s Brookhaven National Laboratory.

Prerequisite: undergraduate equivalent physics and chemistry.

Fall, Spring, 4 credits, Letter graded (A, A-, B+, etc.)

ESM 554: Chemical & Biological Weapons: Safeguards and Security
This course deals with the fundamentals of chemistry and biochemistry related to chemical weapons (CW) and biological weapons (BW) that could be used by terrorists. Topics include

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CW and BW history, production, control, detection, identification, and emergency response measures to deal with intended or unintended release and escape, and security measures to protect and control stockpiles.

Prerequisite: Undergraduate equivalent chemistry, biochemistry, and microbiology.

Fall, Spring, 4 credits, Letter graded (A, A-, B +, etc.)

ESM 555: Synchrotron X-ray Analysis: Introduction to Advanced Techniques

In this course, world-leading experts from Brookhaven National Laboratory (BNL) will discuss advanced concepts in synchrotron X-ray and electron-based methodologies for studies of various materials in multiple scientific disciplines spanning from physical and chemical sciences to materials engineering. Emphasis is on applying fundamental knowledge of these cutting-edge methodologies to real-world materials studies in a variety of disciplines. Main aim of this course is to provide knowledge on broad range of X-ray based techniques available at BNL to assist the future research of the students that may involve use of advanced techniques at synchrotron light sources. The targeted audience includes graduate students and advanced undergraduate students in materials science, chemical engineering, physics, chemistry, geosciences and other related fields.

3 credits, Letter graded (A, A-, B+, etc.)

ESM 560: Risk Assessment, Regulation, and Homeland Security

The course focus is on risk assessment associated with nuclear, chemical and biological weapons as it relates to Homeland Security. Topics include air dispersion, uncertainty analysis, exposure measurements, epidemiology, toxicology, regulatory issues, risk management, risk communication, risk perception, and risk preparedness. The course will also cover laws and regulation, and disaster preparedness, various acts passed by the U.S. Congress to regulate water, air, and controlled substances.

Prerequisite: undergraduate or equivalent physics, math and chemistry.

Fall, Spring, 4 credits, Letter graded (A, A-, B+, etc.)

ESM 561: Crystal Growth Technology

The main goal of this course is to introduce graduate students to the fundamentals and physical principles that govern the process of crystal growth and show them how to apply those principles to design and engineer growth systems for different crystalline materials. While microscopic theory of nucleation and growth kinetics will be an essential part of this course, its core will mainly focus on applying transport phenomena and thermodynamics of chemical reactions to the design of processing reactors. As part of the academic requirements associated with this course, students will form teams and work on the virtual design of crystal growth reactors using software packages for transport phenomena modeling.

Fall, 3 credits, Letter graded (A, A-, B+, etc.)

ESM 562: Traditional Fossil Fuels

The course will focus on the original and history of traditional fossil fuels, coal, petroleum and natural gas. Discuss mining methods and the role of fossil fuels play in the post-industrial revolution era. A comparison of the three fossil fuels with respect to their energy content, CO2 output and associated environmental impact tied to global warming.

Fall, 3 credits, Letter graded (A, A-, B+, etc.)

ESM 566: Fuel Combustion

The course will focus on combustion process for heat and power generation. Describe both fundamentals and actual systems involving fossil fuels and upcoming CO2-neutral biofuels. Emphasis on fuel combustion in stationary equipment, emissions characteristics of burning fuels and challenges in developing the next-generation combustion equipment.

Spring, 3 credits, Letter graded (A, A-, B+, etc.)

ESM 569: Biofuels

The course will focus on biofuels- a promising option to replace fossil fuels. Topics to be covered include crop-growth cycle and its impact on land-use, biomass to various fuel options, their integration into the exiting energy delivery infrastructure and potential benefit in CO2 reduction.

Spring, 3 credits, Letter graded (A, A-, B+, etc.)

ESM 575: The Material World

The evolution of the Material World starting from the Big Bang, the creation of stars and galaxies, the nucleosynthesis of the elements in supernova explosions, formation of the Earth and Solar System, human adaptation of Earth resources to create the Modern World will be discussed. In this process we will discover the fundamental laws governing material behavior and explore the cosmic significance of our existence.

3 credits, Letter graded (A, A-, B+, etc.)

ESM 595: ESM MS Project Course

May be repeated 2 times FOR credit.

ESM 599: Research

Fall and Spring, 1-12 credits, S/U grading

May be repeated for credit.

ESM 604: Seminar in Ultrasonic Methods and Internal Friction in Solids

Review of advanced measurement techniques in the field of ultrasonics coupled with quantitative descriptions of experimental variables related to the sample microstructure. Applications to optical, electrical, and mechanical properties are discussed. Use of ultrasonics for nondestructive evaluation is considered.

Prerequisite: ESM 513

Spring, 3 credits, Letter graded (A, A-, B+, etc.)

ESM 608: Seminar in Catalysis


Fall, 3 credits, Letter graded (A, A-, B+, etc.)

ESM 614: Seminar in Diffusion in Solids

Diffusion in solids is considered in detail, including solution of the transport equations for volume, grain boundary, and surface diffusion. Kirkendall effect and other diffusion phenomena, atomic mechanisms of diffusion, correlation effects, etc. Next, the theory of processes in which diffusion plays an important role is considered, such as ionic conduction, oxidation of metals, and the sintering of solids.

Spring, 3 credits, S/U grading

ESM 694: Directed Studies in Materials Science

This course is designed for research on special topics in Materials Science and is directed by a faculty member. Designed for students who want to research areas that are not typically covered by regular coursework. Registration requires the faculty member's and departmental approval. Cannot be repeated for credit with the same faculty member.

3 credits, Letter graded (A, A-, B+, etc.)

May be repeated for credit.

ESM 695: Graduate Internship

Participation in private corporations, public agencies, or non-profit institutions for ongoing research activities related to thesis research.
Students will be required to have a faculty coordinator as well as a contact in the outside organization, to participate with them in regular consultations on the project, and to submit a final report to both. Not accepted for credit toward the M.S. degree.

1-3 credits, S/U grading
May be repeated for credit.

ESM 696: Special Topics in Materials Science
Supervised reading and discussion of selected publications in particular fields of Materials Science. This course is designed primarily for advanced graduate students who are, or expect to be, involved in research in these areas, although other students may enroll with permission of the instructor.
Fall and Spring, 3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

ESM 697: Materials Science Colloquium
A weekly series of lectures and discussions by visitors, local faculty, and students presenting current research results.
Fall and Spring, 0-3 credits, S/U grading
May be repeated for credit.

ESM 698: Practicum in Teaching
Fall and Spring, 0-3 credits, S/U grading
May be repeated for credit.

ESM 699: Dissertation Research on Campus
Prerequisite: Advancement to candidacy (G5). Major portion of research must take place on SBU campus, at Cold Spring Harbor, or at the Brookhaven National Lab.
Fall, Spring, and Summer, 1-9 credits, S/U grading
May be repeated for credit.

ESM 700: Dissertation Research off Campus - Domestic
Prerequisite: Must be advanced to candidacy (G5). Major portion of research will take place off-campus, but in the United States and/or U.S. provinces. Please note, Brookhaven National Labs and the Cold Spring Harbor Lab are considered on-campus. All international students must enroll in one of the graduate student insurance plans and should be advised by an International Advisor.
Fall, 1-9 credits, S/U grading
May be repeated for credit.

ESM 701: Dissertation Research off Campus - International
Prerequisite: Must be advanced to candidacy (G5). Major portion of research will take place outside of the United States and/or U.S. provinces.

Domestic students have the option of the health plan and may also enroll in MEDEX. International students who are in their home countries are not covered by the mandatory health plan and must contact the Insurance Office for the insurance charge to be removed. International students who are not in their home countries are charged for the mandatory health insurance. If they are to be covered by other insurance plans they must file waivers by the second week of classes. The charge will only be removed if the other plans are deemed comparable. All international students must receive clearance from an International Advisor.
Fall, 1-9 credits, S/U grading
May be repeated for credit.

ESM 800: FULL TIME SUMMER RSH
May be repeated for credit.

ESS

Earth and Space Sciences

ESS 501: Foundations of Earth Science
Comprehensive analysis of the New York State Earth Science Curriculum taught by an experienced Earth Science teacher. This course is intended for science teachers and science education students.
Fall, 3 credits, Letter graded (A, A-, B+, etc.)

ESS 511: Pine Barrens Sustainability
The ecologically diverse Long Island Pine Barrens region provides a habitat for a large number of rare and endangered species, but faces challenges associated with protection of a natural ecosystem that lies in close proximity to an economically vibrant urban area that exerts intense development pressure. In this course we will consider the interaction of the ecological, developmental and economic factors that impact the Pine Barrens and the effectiveness of decision support systems in promoting sustainability of the Pine Barrens.
3 credits, Letter graded (A, A-, B+, etc.)

ESS 522: The Planets
A study of present knowledge of planets and their satellites, the interplanetary medium, asteroids, meteorites, comets, and the Sun. Emphasizes the methods of science including the history of astronomical sciences, ongoing deep-space missions, modern astronomical instrumentation, and exoplanet discoveries. Emphasis will be placed on topics contained in the Earth Science curriculum in New York State. A research report is required. This course is intended for science teachers and science education students and requires knowledge of trigonometry, algebra and introductory college level physics.
Offered
Fall, 3 credits, Letter graded (A, A-, B+, etc.)

ESS 523: Collisions in the Solar System
A discussion of the evidence that comet and asteroid impacts have played a significant part in the evolution of the Earth, and other planets of the solar system, as well as an assessment of the actual and perceived hazard posed by terrestrial impacts and discussion of what can be done about it. Research report required. This course is intended for science teachers and science education students and requires knowledge of trigonometry, algebra and introductory college level physics. Offered
Spring, 3 credits, Letter graded (A, A-, B+, etc.)

ESS 524: The Universe
The origin, evolution, and ultimate fate of the universe. The course begins with a historical approach with emphasis on the evolution of cosmological ideas from geocentric universes to the Big Bang. Consideration of the evolution of the universe from the earliest moments after the Big Bang to the distant future, including the formation of the galaxies, stars, and planets. Research report required. This course is intended for science teachers and science education students and requires knowledge of trigonometry, algebra and introductory college level physics.
Co-scheduled with AST 304 The Universe.
Spring, 3 credits, Letter graded (A, A-, B+, etc.)

ESS 532: Atmospheric Fundamentals
This course considers: the principles of atmospheric thermodynamics to assess adiabatic and saturated adiabatic processes; the concepts of radiative transfer such as blackbody radiation, scattering, absorption, and emission by molecules and particles will be discussed; tropospheric and stratospheric chemistry with its subsequent effects on air pollution and chemical cycles; meteorological physical concepts such as geostrophic and gradient winds, and general circulation; and the microphysics of cloud formation and precipitation. Research report required. This course is intended for science teachers and science education students.
Offered
Fall, 3 credits, Letter graded (A, A-, B+, etc.)
ESS 533: Global Climate
This course explores the fundamental physical processes associated with various weather phenomena: tropical cyclones, extratropical cyclones, fronts, convective storms, and local air-sea and mountain flows. The latest analysis techniques, datasets, and tools will be used to understand the climatology and structural evolution of these weather phenomena. Basic forecasting techniques will be applied using observations and numerical model output. Research report required. This course is intended for science teachers and science education students. Offered Fall, 3 credits, Letter graded (A, A-, B+, etc.)

ESS 541: Earth's Surficial Environment
This course includes creating and using topographic maps, weathering, soil development, stream systems, groundwater, glacial geology, mass movement, erosion and deposition. Instruction will include lectures and laboratory exercises. Research report required. This course is intended for science teachers and science education students. Offered Fall, 3 credits, Letter graded (A, A-, B+, etc.)

ESS 542: Tectonic Environment
The use of maps in recognizing, describing and interpreting tectonic features in New York State and around the world; understanding the origin of structural features of the earth's crust and interior; using seismic data to understand the tectonic significance of earthquakes and to describe the earth materials through which seismic waves travel; and understanding the role of plate tectonics in the earth's geologic evolution. Instruction will include lectures and laboratory exercises. Research report required. This course is intended for science teachers and science education students. Offered Spring, 3 credits, Letter graded (A, A-, B+, etc.)

ESS 543: Rocks and Minerals
Identification, properties, formation and occurrence of rock-forming minerals: characterizing igneous, sedimentary and metamorphic rocks including the diverse geologic settings in which they occur with emphasis on their occurrence in the Metropolitan New York area. Instruction will include lectures and laboratory exercises. Research report required. This course is intended for science teachers and science education students. Offered Fall, 3 credits, Letter graded (A, A-, B+, etc.)

ESS 544: Geology of New York
The course will explore the geologic development of New York from the Mesoproterozoic to the present and will also explore how the rocks were dated using radiometric methods and fossils. Research report required. This course is intended for science teachers and science education students. Offered Spring, 3 credits, Letter graded (A, A-, B+, etc.)

ESS 548: Directed Studies
Special studies directed by various faculty members to be taken for variable and repetitive credit. Fall, Spring, and Summer, 1-3 credits, Letter graded (A, A-, B+, etc.) May be repeated for credit.

ESS 589: Research for Earth Science Teachers
This course is intended to provide science teachers or graduate students in the Science Education program an opportunity to obtain research experience. A written report is required. Fall, Spring and Summer, 1-3 credits, Letter graded (A, A-, B+, etc.) May be repeated for credit.

ESS 600: Independent Research
This course is required for students in MAT Earth Science and MS in Geosciences with a concentration in Earth and Space Sciences to document that the student has completed an independent research project as part of a graduate earth science academic or research course. S/U grading

ESS 601: Topics in Earth and Space Sciences
This course is intended for science teachers or science education students. Fall, Spring, and Summer, 1-3 credits, Letter graded (A, A-, B+, etc.) May be repeated for credit.

ESS 610: Capstone Project in Earth and Space Sciences
This required capstone project considers unifying themes or "big ideas" such as scale and structure, models, stability, and change, systems and interactions, energy and time as they apply to astronomy, atmospheric science and geology. This capstone course integrates "big ideas" across the earth and space sciences. Students should have taken at least two undergraduate or graduate courses in each of astronomy, atmospheric science and geology. I credit, Letter graded (A, A-, B+, etc.)

EST Technology and Society

EST 500: Foundations of Educational Technology for Administrators
This course is designed to teach administrators basic principles surrounding educational technology throughout the school and/or district. Students will explore and discuss critical issues surrounding technology in education. Students will understand
administrative technology applications, web 2.0 presentation tools, Internet protocol, cyber safety and cyber bullying, Google Apps, social networking, collaboration tools, portable devices and apptivities. The semester project for this course is the development of a needs assessment and research of an educational technology for your school/district.

3 credits, Letter graded (A, A-, B+, etc.)

EST 501: Educational Technology Integration for Administrators

This course is designed to teach administrators how to integrate educational technology within their school/district. Students will understand ISTE Technology Standards for Administrators, the National Technology Plan and the Common Core Standards in relation to educational technology. Students will explore distance education, media streaming and communication tools such as Twitter and Facebook. They will review management systems, data collection/analysis tools and technology funding resources. Students will also learn how to evaluate technology integration throughout their school and/or district. The semester project for this course is the development of an implementation plan and the evaluation of an educational technology that may be used in your school or district.

3 credits, Letter graded (A, A-, B+, etc.)

EST 502: Ethical Decisions in Engineering

“The engineering design process involves more than material choices and cost concerns. Individuals and organizations that create technological innovation must also address social and, more importantly, ethical issues. This course will review formal frameworks drawn from classical ethics. These frameworks will be used as a basis for considering case studies drawn from a variety of engineering disciplines. In addition, modern multi-disciplinary design approaches such as Value Sensitive Design and Biophilic Architecture will be considered as exemplar templates for the explicit incorporation of social and ethical principles into product development.

3 credits, Letter graded (A, A-, B+, etc.)

EST 508: Projects in Global Operations Management

This is a capstone course. Students will demonstrate what they have learned during their masters studies. This course will review several significant research areas in modern Global Processing Management Operations. Topics include Performance Management, Lean Management, Six Sigma Management in conjunction with Cloud Computing and Cloud computing applications. The students will be given a selected case study and asked to demonstrate their knowledge by proposing a comprehensive technical and management solution. Students will use software engineering tools such as Data Flow Diagram (DFD) and Unified Modeling Language (UML) to analyze and design an implementation plan using cloud computing infrastructure, platform and services.

3 credits, Letter graded (A, A-, B+, etc.)

EST 510: Fundamentals of Technology in Higher Education

Higher education is impacted by technology on an ever changing scale. Students are bringing in new technology every day. This course will show higher education instructors what technology is available, how higher education students are using technology and offer innovative ways to use that technology to motivate students to learn. Throughout the course students learn about best practices in higher education, a number of web based productivity and course management tools, Cyber-ethics and digital footprint, organization of your digital world, collaborating with technology, social media, virtual worlds as well as presentation strategies and tools. The culminating project for this course is the research, assessment, analysis and presentation of a college student profile. Semesters offered Fall, Spring, 3 credits, Letter graded (A, A-, B+, etc.)

EST 511: Infusing Technology into Higher Education Curriculum

The power of technology allows higher education instructors to teach and motivate students to learn in ways never thought possible. This course will show students how to fully integrate technology into the curriculum. For the semester project, students will review and modernize an existing course to make learning more effective and exciting for the higher education student. Students will learn the best way to update courses by understanding different instructional design models, content management systems and the Google Apps for Education suite. Students will enhance his/her web presence and digital profile by harnessing the power of social media and personal learning networks. Students will also explore potential technology grant opportunities for his/her curriculum, department or instructional area. Semesters offered, Fall, Spring, 3 credits, Letter graded (A, A-, B+, etc.)

EST 516: Science for Society I

This is part one of an interdisciplinary course sequence (1 credit each) is designed for students in computer science (CS) and students of technology and society (DTS). Students taking this course will enhance their abilities to critically think and build awareness for science and technology (ST) and their societal aspects. They will learn strategies for assessing important questions such as: what should I focus my efforts on, where are societal needs, what policies are required or can be taken advantage of, how can I possibly influence policy, and finally, what are the dangers when developing new ST. To teach these topics the course takes a practical approach. The first section of the sequence examines historical science and technology successes and failures. Then, in the second section, teams composed of students from both the CS and DTS departments conduct case studies of existing ST or design and implement new ST under the perspectives of the course. 1 credit

1 credit, Letter graded (A, A-, B+, etc.)

EST 517: Science for Society II

This is part two of an interdisciplinary course sequence (1 credit each) is designed for students in computer science (CS) and students of technology and society (DTS). Students taking this course will enhance their abilities to critically think and build awareness for science and technology (ST) and their societal aspects. They will learn strategies for assessing important questions such as: what should I focus my efforts on, where are societal needs, what policies are required or can be taken advantage of, how can I possibly influence policy, and finally, what are the dangers when developing new ST. To teach these topics the course takes a practical approach. The first section of the sequence examines historical science and technology successes and failures. Then, in the second section, teams composed of students from both the CS and DTS departments conduct case studies of existing ST or design and implement new ST under the perspectives of the course. 1 credit

1 credit, Letter graded (A, A-, B+, etc.)

EST 519: Systems Engineering Management

Systems engineering (SE) establishes the technical framework for delivering material capabilities to the customer. SE provides the foundation upon which everything else is built and supports program success. SE ensures the effective development and delivery of capability through the implementation of a balanced approach with respect to cost, schedule, performance and risk, using integrated, disciplined and consistent SE
activities and processes regardless of when a program enters the developmental life cycle.

3 credits, Letter graded (A, A-, B+, etc.)

EST 521: The Social and Global Impact of Technology in Education
This course will explore educational systems and practices globally and how the use or lack of use of technology within education impacts society. Inversely students will research how society dictates the use or lack of use of technology in education within the specified educational system. Throughout the course, students will focus on one region of the world and research the current educational system and specifically how they use technology within education. In their research the will find out what technology is available within the educational system, how that technology is used, explore the effectiveness of the technology and research the social impact of that technology use. Students will connect with a global participant via distance communication or video conferencing to gain real world knowledge of the educational system and the use of technology for the specified region. The culminating project is a research based project that assesses the use of technology within the selected global region, offers solutions on how to improve the use of technology and compares that system and the use of technology with our own use of technology locally in our current educational system.

Fall, Spring, and Summer, 3 credits, Letter graded (A, A-, B+, etc.)

EST 522: Integrating Educational Technology into Social Studies and Language Arts
Students will learn how to integrate technology into Social Studies and Language Arts curriculum using the ISTE/NETs standards and National Technology Plan to aid in the delivery of instruction. Students will develop a push-in training model focused on the Social Studies and Language Arts Core Curriculum and subject related needs. Students will meet with a Social Studies and Language Arts educator, assess their needs, design an educational technology push-in around those needs and push-in the training with the educator to their class. The culminating activity for this course is to conduct the push-in training with a Social Studies and Language Arts educator and their class. After the push-in training students will work with the instructor to evaluate the delivery and content of the lesson as well as assess the outcome and results of educator learning.

Fall, Spring, and Summer, 3 credits, Letter graded (A, A-, B+, etc.)

EST 523: Integrating Educational Technology into Mathematics and Science
Students will learn how to integrate technology into Math and Science curriculum using ISTE/NETs standards and the National Technology Plan to aid in the delivery of instruction. Students will develop an educational technology workshop focused on the Math and Science Core Curriculum and subject related needs. Students will meet with a group of Math and Science educators, assess their needs, design an educational technology workshop around those needs and deliver the workshop to the educators. The culminating activity for this course is to conduct the developed workshop to a group of Math and Science educators. After the delivery of the workshop, students will work with the instructor and classmates to evaluate the delivery and content of the lesson as well as assess the outcome and results of educator learning.

Fall, Spring, and Summer, 3 credits, Letter graded (A, A-, B+, etc.)

EST 524: The Role of Educational Technology Specialist
In this course students will learn the role and responsibilities of an Educational Technology Specialist. Students will research new educational technologies and resources that enhance classroom learning. They will learn how to navigate the social, political, ethical and legal issues surrounding educational technology. Students will learn how to provide ongoing professional development which includes scheduling and conducting workshops, push-ins and individual appointments, and working with educators to develop lesson plans and student projects. Students will learn how to infuse the ISTE Standards and the ideology of the National Technology Plan into curriculum and learn to assess the effectiveness of student learning using technology in the classroom. Throughout the course students will work the instructor to: develop a plan for future integration of technology into the curriculum addressing specific needs, develop a data driven needs assessment based on current goals and technology available, incorporate the best model for the specific group of educators and decide on a focus for technology integration using workshops, push-ins or one-on-one sessions to deliver instruction. The culminating activity for this course is the submission of a year-long technology integration plan.

3 credits, Letter graded (A, A-, B+, etc.)

EST 525: Google for Education: Foundations
Google for Education (GfE) is a powerful suite that now seamlessly integrates into curricula and district technology goals. In this course, students will learn the tools necessary to become a Google Certified Trainer. Students will create and learn how to use Google for Education tools in their classroom. They will also develop a comprehensive knowledge of a number of different products within Google Apps including - Drive, Calendar, Gmail, Sites, Classroom and more. Students will focus on skills necessary to become a Google Certified Trainer through hands-on coursework, review and preparation for the Google for Education Exams. The culminating activities for this course are a showcase of best practices highlighting Google for Education tools, the preliminary work for your portfolio, and the completion of the certification requirements. This class cannot be used to satisfy master’s degree requirements.

3 credits, Letter graded (A, A-, B+, etc.)

EST 526: Google for Education: Curriculum Integration
In this course, students will learn how to fully integrate the Google for Education products beyond the core apps, including Google Groups,Earth, Scholar, Blogger, and Google +. Students will complete the Google modules as well as they develop their portfolio. They will begin to deliver training by conducting a live webinar session which highlights Google tools or apps and sharing best practices. The culminating activities for this course are the development of a portfolio highlighting the lessons or trainings they conducted throughout this program. This class cannot be used to satisfy master’s degree requirements.

3 credits, Letter graded (A, A-, B+, etc.)

EST 527: Google for Education: Professional Development
Students will explore educational best practices and examples of materials needed to submit the application to become a Google Certified Trainer. Students will thoroughly review Google for Education best practices, organize additional training materials and create their portfolio. Through the delivery of training sessions or lessons, students will focus on the power of Google for Education tools and their use in PK-12 education. Students will also create, run their own workshop. The culminating activity of this course is the completion of the portfolio with a screencast and the submission of the application to Google. This class cannot be used to satisfy master’s degree requirements.

3 credits, Letter graded (A, A-, B+, etc.)
EST 528: Teaching with Interactive Whiteboards and Immersive Technologies
Interactive whiteboards and other immersive technologies have changed the way educators deliver instruction. They are a technology that has enormous potential to impact student learning in a hands-on, kinesthetic way. Throughout this course students will explore best practices using immersive technologies within education. Students will learn how to effectively integrate interactive whiteboards, interactive projectors and cameras, learner responses systems, document cameras as well as other technologies. The culminating project for this course a comprehensive lesson plan utilizing immersive technology hardware and the associated software within the curriculum.  
3 credits, Letter graded (A, A-, B+, etc.)

EST 529: Supporting Common Core Standards Using Educational Technology
In this course students will learn how to support Common Core Standards through the infusion of educational technology by identifying, sharing, and exploring technology tools that support all curricula. Students will unpack the Common Core Standards and analyze and discuss best practices that effectively integrate technology to promote rigorous teaching and learning. The culminating assignment for this course is the design, delivery, reflection, revision and presentation of your technology infused Common Core lessons  
3 credits, Letter graded (A, A-, B+, etc.)

EST 530: Internet Electronic Commerce
Topics addressed in this course include: technology infrastructure, business models and concepts, technological skills needed to build an E-Commerce web site, marketing, communications, security and encryption, payment systems in E-Commerce/M-commerce. Financial transactions, advertising models, content ownership and the prospects for E-Commerce are also covered.  
Summer, 3 credits, Letter graded (A, A-, B+, etc.)

EST 531: Virtual Distance Management Course
In today's global corporations, the challenges associated with leadership and management has grown increasingly difficult and complex. More and more, companies are using networked organizational models to deliver work and interact with customers. As globalization and diffused networks of people and companies combine, issues related to virtual/distributed employees, partners and customers have moved front and center. Implications for leadership has grown beyond current skill sets drawn from traditional academic fields and training programs. The Virtual Distance Management course offers business students a powerful model and a set of proven practices to address these challenges in a unique way. Students will learn to: Understand and diagnose barriers to effective communication Develop ways to work with others using virtual technologies and social media Contribute to high performance, cross-discipline and cross-cultural teams Management strategies for the globally distributed workforce Virtual Distance, pioneered by Karen Sobel Lojeski, is a conceptual as well as quantitative approach that helps to explain organizational behavior changes when much of our communications are electronically mediated. Understanding these changes and how they impact organizational outcomes is critical to leaders and managers around the world. During this course, students will be exposed to both theoretical models and real-life case studies to more fully develop knowledge and skills for working in the digital age. Students will gain an in-depth understanding of Virtual Distance and how this growing phenomenon impacts critical success factors such as productivity, innovation, and employee engagement and satisfaction. Students will also get hands-on experience with Virtual Distance Index data. Drawing from over 700 project teams from around the world, students will learn how to interpret Virtual Distance data  
3 credits, Letter graded (A, A-, B+, etc.)

EST 534: The Lean Launch Pad: Turning a great idea into a great company
This course provides real world, hands-on learning of what it's like to actually start a high-tech company. This class is not about how to write a business plan, and the end result is not a PowerPoint presentation to venture capitalists. Instead, students will get their hands dirty talking to customers, partners and competitors as they encounter the chaos and uncertainty of how a startup actually works. Students work in teams learning how to turn a great idea into a great company. They will learn how to use a business model to brainstorm each part of a company and customer development to get out of the classroom to see whether anyone other than themselves would want/use their product. Finally, they will see how agile development can help them rapidly iterate their product to build something customers will use and buy. Offered in Fall and Spring.  
3 credits, Letter graded (A, A-, B+, etc.)

EST 535: Electric Power Systems
Electric power system is at the center of achieving mid-century carbon neutrality to address climate change. This course deals with the physics, design, plan, and operation of the electric power systems, essentially the power grid. We will first discuss the engineering principles of the electric power systems. We will cover the basic components of electric power systems, including generation technologies, transmission and distribution, electricity loads, transformers, and safety equipment. We will then discuss the design and operation of the power systems. We will cover power system planning, power system operation and control, and emerging technical and policy issues in the electricity industry.  
3 credits, Letter graded (A, A-, B+, etc.)

EST 536: Resilience in Urban Environments
Resilience lacks a universally agreed-upon definition, in part due to its multi-dimensional nature that crosses disciplines, and this inconsistency in terminology and framing is reflected in current research. For this course, we adopt a newer, more dynamic framing of resilience that incorporates change and adaptation: Cities and buildings are operated by social actors; they may be stationary engineering structures, but they are not static, and during a disruption they evolve and change based on the decisions made by people. Thus, this class focuses on conceptual and theoretical frameworks for resilience but applies them to important social science questions in the urban built environment, such as vulnerability, decision making, risk perception, organizational behavior, and policy formation.  
3 credits, Letter graded (A, A-, B+, etc.)

EST 540: Environmental Management
This is an introduction to environmental management, and will focus on the interplay between science and public policy. Concepts include problem identification and definition, collection and analysis of relevant data to produce information, and the roles of public perception and action in ultimately determining outcomes when consensus is not reached. Specific fields to which these concepts will be applied will be solid waste management and coastal management. Current local problems will be used to illustrate the broader conceptual issues. Offered as MAR 514, EST 540 and CEY 501. 3 Credits, ABCF Grading
EST 541: Long Island’s Groundwater
This course will cover basic groundwater concepts in unconsolidated sediments, and examine contamination issues in light of Long Island’s particular hydrogeology, land use, and waste management history. Mathematical principles will be discussed but not stressed; scientific and technical papers discussing particular concepts or problems, including important local examples, will be closely read. Prerequisite: Permission of instructor. Offered as MAR 521 or HPH 673. Offered in Fall, 3 credits, Letter graded (A, A-, B+, etc.)

EST 542: Water and Wastewater Engineering Practices
This course will provide basic engineering concepts and practices associated with water supply and wastewater management, with an emphasis on New York metropolitan area technologies. Topics covered will include water supply and distribution, wells, water quality testing and regulation, onsite, package and standard wastewater treatment, and stormwater collection. Policy issues considered will include source water protection and wastewater impact mitigation programs. Offered in Fall, 3 credits, Letter graded (A, A-, B+, etc.)

EST 546: Integrating Technology, Policy and Financing Instruments to Catalyze Climate Finance
The sums involved in a shift to a low-carbon society are daunting but not impossible to achieve. The world is planning to invest over $15 trillion in fixed-asset investments in the next 10 years. Rather a problem of capital generation, the key challenge of financing the transition towards a low carbon society is to redirect existing and planned capital flows from traditional high-carbon to low-carbon investments. This course is designed to allow students to: (1) Review a number of public policies, public finance mechanisms and market-based instruments designed to shift investments from fossil fuels to more climate friendly alternatives over the past few years; (2) Gain knowledge of the global commercial, political, innovation and technological challenges and opportunities in the transition to a low-carbon society; (3) Develop and practice professional skills in raising and spending public finance to catalyze capital towards low carbon and climate resilient development; and (4) Develop and practice professional skills in accessing carbon finance and designing innovative financing instruments. This course is aimed at engineering students who are interested in the energy challenges in a carbon-constrained world and their implications to technology innovation; at business-and public-administration students and at mid-career professionals who want to develop innovative financing solutions to real-world energy and environmental problems. Offered: Fall, Spring, 3 credits, Letter graded (A, A-, B+, etc.)

EST 547: Advanced Problems in Integrated Planning: Theory, Practice, and Analytical Tools
This course explores in depth new theories and practical applications of integrated planning through the lens and land use, transportation and urban infrastructure systems. A series of problem sets is undertaken in close coordination with the instructor to produce a portfolio of networked research which, with further research, can be publishable quality. Offered Summer, 3 credits, Letter graded (A, A-, B+, etc.)

EST 551: The Atom and Environmental Radiation in the Nuclear Age
This course will address technical and societal aspects relating to nuclear power and the general issue of environmental radioactivity. It will cover basics of the nuclear industry and the nature of radioactivity. This includes the production, storage, and disposal of diverse radionuclides emanating from the nuclear fuel cycle and nuclear weapons testing. The properties of major radionuclides will be explored. The course will also consider the complex issue of biological risks posed by radionuclides at different doses to living organisms, including man. Economic and political constraints on nuclear power generation will be discussed for the US and other countries, as will the actual and perceived risks associated with environmental radioactivity. 3 credits, Letter graded (A, A-, B+, etc.)

EST 553: Nuclear Security
The course will familiarize students with the fundamentals of nuclear physics, radiation, mining, weapons and fuel cycle, other than producing electricity, as it pertains to nuclear power plants. Topics include nuclear detection, devices to safeguard nuclear materials from terrorist threats, needed physical protection for safe handling and its relevance to Homeland Security. The course combines lectures with hands-on experience at the newly installed nuclear detection facility located at the nearby United States Department of Energy's Brookhaven National Laboratory. Prerequisite: Undergraduate equivalent physics and chemistry. Fall, Spring, 4 credits, Letter graded (A, A-, B+, etc.)

EST 554: Chemical & Biological Weapons: Safeguards and Security
This course deals with the fundamentals of chemistry and biochemistry related to chemical weapons (CW) and biological weapons (BW) that could be used by terrorists. Topics include CW and BW history, production, control, detection, identification, and emergency response measures to deal with intended or unintended release and escape, and security measures to protect and control stockpiles. Prerequisite: Undergraduate equivalent chemistry, biochemistry, and microbiology. Fall, Spring, 4 credits, Letter graded (A, A-, B+, etc.)

EST 555: Preventing Weapons Proliferation
The student will learn: what some of the key international tools to stem weapons proliferation are, how they have developed over the last 50 years, and how they work; the kinds of technologies used to develop nuclear, chemical, or biological weapons & missile delivery systems; and the complexities & methods of controlling these technologies. The student will also learn about the use of UN Security Council sanctions, and about multilateral [e.g., EU, ECOWAS] and national sanctions; and about how interfering illicit transfers does or does not work. The course will emphasize how technology, international law, and international and domestic politics all play important roles in the evolution, current practice, and effectiveness of the international nonproliferation regime. 3 credits, Letter graded (A, A-, B+, etc.)

EST 556: Nuclear Nonproliferation & International Safeguards
The student will learn the history of the nuclear nonproliferation regime since 1946, with emphasis on the evolution of concepts & practice. The student will also learn the variety and complexity of motivations for governments to seek nuclear weapons, and in many cases, to foreswear nuclear weapons. The course will emphasize how nuclear energy technologies, verification technologies, international legal practice, and policies all play important roles in the evolution, current practice, and effectiveness of the international nuclear nonproliferation regime. 3 credits, Letter graded (A, A-, B+, etc.)

EST 557: Nuclear Energy-the nuclear fuel cycle & technologies
A decision support system (DSS) is a computer based applications within school curriculum. Students will also learn how to use a number of online planning and student project work. Students and presentation applications for educator technology and computer applications into the curriculum. Students will learn how to use the basic pedagogical issues and social impact of new and current computer technologies. The following skills will be addressed; electronic communication, application-based projects, information management, assessment, and the societal impacts of computer based technologies. Students having completed EST 565 in a prior semester can not receive credit for EST 563. EST 563 and EST 565 may be taken in the same semester.

Fall, 3 credits, Letter graded (A, A-, B+, etc.)

EST 565: Foundations of Technology in Education

Throughout this course students will explore the basic pedagogical issues and social impact of using technology in education. This course examines the basic principles of integrating technology and computer applications into the curriculum. Students will learn how to use and integrate word processing, spreadsheet, and presentation applications for educator planning and student project work. Students will also learn how to use a number of online based applications within school curriculum.

3 credits, Letter graded (A, A-, B+).

EST 560: Risk Assessment, Regulation, and Homeland Security

The course focus is on risk assessment associated with nuclear, chemical and biological weapons as it relates to Homeland Security. Topics include air dispersion, uncertainty analysis, exposure measurements, epidemiology, toxicology, regulatory issues, risk management, risk communication, risk perception, and risk preparedness. The course will also cover laws and regulation, discouraging terrorism, and disaster preparedness, various acts passed by the U.S. Congress to regulate water, air, and controlled substances. Offered as EST 560 or HPH 656. Prerequisite: Undergraduate or equivalent physics, math and chemistry. Fall and Spring, 4 credits, Letter graded (A, A-, B+).

3 credits, Letter graded (A, A-, B+).

EST 561: Sensing Technologies for Disaster Risk Reduction

This graduate seminar will survey the main topics in the emerging field of digital technology management for disaster risk reduction. The first several weeks of the course introduce major perspectives and conceptual approaches to understanding the new role of digital technologies in disaster risk reduction. Subsequently, the course focuses on more specific topics including the evolution of next-generation public safety networks, innovation and such digital technologies as robotics, augmented and virtual reality, big data, mobility, block chain and artificial intelligence.

3 credits, Letter graded (A, A-, B+).

EST 559: Mobile Revolution in Disaster Risk Reduction

This course explore three themes: [1] current and future trends of three major mobile technologies applied to disaster risk reduction (ICT, [mobile phones, service apps, Remote GIS, GPS], energy [batteries, microgrids], and other technologies increasingly repurposed and adapted toward mobility (drones, ad hoc networks, base stations, wearables, IoT, smart grids), [2] combined with proven tactics to achieve successful collaborative disaster management and trust relationships between three groups (government/corporate 'big data' aggregation and sharing, emergency response personnel, and local knowledge of citizens, NGOs, businesses, and volunteers), [3] in order to effectively reduce vulnerability and inequality before, during, or after natural hazards and/or human disasters toward a goal of more resilient, equitable, sustainable development.

3 credits, Letter graded (A, A-, B+).

EST 558: Digital technologies in disaster risk reduction

“This seminar surveys major topics in the emerging field of digital technology management for disaster risk reduction. The first several weeks of the course introduce major perspectives and conceptual approaches to understanding the new role of digital technologies in disaster risk reduction. Subsequently, the course focuses on more specific topics including the evolution of next-generation public safety networks, innovation and such digital technologies as robotics, augmented and virtual reality, big data, mobility, block chain and artificial intelligence.

3 credits, Letter graded (A, A-, B+).

Nuclear energy has many applications beyond the well known (and controversial) civil nuclear power plant. These applications include medical and industrial isotope production, research reactors, particle accelerators, propulsion reactors, and nuclear weapons. Supporting these applications is a complex infrastructure involving several diverse scientific, engineering, and industrial processes. One of the key processes is the nuclear fuel cycle, involved principally in civil nuclear power and related civil nuclear activities, from uranium mining to spent fuel reprocessing. However, the same set of technologies can be used to manufacture nuclear weapons; thus these technologies become a double-edged sword. This course provides a comprehensive first look at this complex of technologies for those interested in nuclear weapons proliferation, nuclear energy, or nuclear safety. It is directed at those with no foundation in nuclear physics or nuclear engineering, but who seek to understand these technologies in terms well beyond those of the layman, but short of the nuclear engineer. Individuals interested in taking this course should have completed a course in algebra. Students should be familiar and comfortable working with exponents and logarithms. Higher levels of math such as calculus will not be utilized in this course.

3 credits, Letter graded (A, A-, B+).
The culminating activity for this course is the design and a presentation of a micro-lesson using one these applications as they would in the classroom.

3 credits, Letter graded (A, A-, B+, etc.)

EST 567: The Internet, Social Networking and Collaborative Environments

In this course students will learn the basic principles of using the Internet for instruction, the science and engineering concepts behind modern communication systems and their impact on education as well as the evolution of the Internet in education. Students will design and create a website and explore the use and social impact of collaborative learning environments and social networking. Students will learn how to evaluate and effectively integrate a variety of educational resources, such as web 2.0 tools and modern communication devices for active learning. Students will also develop a clear understanding of the issues surrounding cyber safety, cyber bullying, and the ethical issues raised by the use of technology in education. The culminating activity for this course is the development and publishing of a collaborative website that showcases the material and skills mastered throughout this course.

Fall, Spring, Summer, 3 credits, Letter graded (A, A-, B+, etc.)

EST 568: Networked Communication Technologies

EST 568 Network Communication Wired and Wireless

This course examines the range of technologies used in teaching, learning, and communication. Instructional technologies both stand-alone and networked are surveyed with a focus on how they can be used effectively to enhance learning. Students will learn fundamental hardware and software principles underlying the development of the Internet and other networked communication tools. Emphasis will be placed on assessment of these technologies in terms of societal impacts and learning outcomes. This course combines topics from EST 565 and EST 567.

Fall, Spring, Summer, 3 credits, Letter graded (A, A-, B+, etc.)

EST 569: Technology in the City

Urban technology includes exciting IT processes and breakthroughs and also mundane but necessary infrastructure such as sewage treatment and traffic control. In this course we will discuss some basic elements of traditional urban technology and examine how modern electronic and information processing technologies have changed and are continuing to change these processes: how the smart City has been and will continue to be implemented. There will be a focus on information and its role in driving innovation but physical improvements to engineering designs will also be considered. Technological lock-in due to structural choices and sunk costs will be a course theme. Course content will change depending on tour opportunities. There are extra course costs for train-subway tickets and field trip lunches.

3 credits, Letter graded (A, A-, B+, etc.)

EST 570: Educational Technology Lesson Development

In this course students will learn principles of instructional design and how to fully integrate technology into daily curriculum. Throughout the course students will plan, develop and evaluate a lesson plan that demonstrates an expertise in the integration of educational technology. Students will apply the skills, techniques, resources and research necessary to effectively create an educational technology inspired lesson plan. The lesson plan may include the use of emerging technologies, distance learning, multimedia projects, collaborative environments, computer applications and Internet resources. The culminating project for this course is the completion of a lesson plan in a specific content area that incorporates multiple modalities of technology into pedagogical practices.

3 credits, Letter graded (A, A-, B+, etc.)

EST 571: Educational Technology Research Methods

This course evaluates the impact and value of educational technology through detailed research based on a number of current topics. Course goals include understanding research methodology and literature and exploring assessment design and implementation. The course includes class discussions and project work based on student learning with technology, access and the digital divide, the National Education Technology Plan, Internet literacy, emerging technologies, virtual schools, and data driven research. The culminating project for this course will be the demonstration and write up of the experience.

3 credits, Letter graded (A, A-, B+, etc.)

EST 574: Distance Learning and Virtual Environments

Web-based distance learning applications are quickly growing within higher education institutions, K-12 schools, and corporate environments. The focus of this course is on the underlying theories, design, and implementation of effective modes of learning. Students will explore virtual schools, virtual learning, virtual environments and other forms of distance education. The social differences between face-to-face and virtual learning will also be examined and discussed throughout the course. Students will explore virtual learning resources and design their own virtual learning lesson. The culminating project for this course will be the demonstration and write up of the experience.

3 credits, Letter graded (A, A-, B+, etc.)

EST 575: Developing Grants and Managing Projects

This course will develop the skills necessary to take a program proposal from idea through reality with an emphasis on new technological resources available to help with this process. Topics include: techniques for successful fundraising, grant writing, program design, staffing, publicity and outreach, and reporting and evaluation. It is designed for current educators and administrators as well as students about to enter the education, social service and health fields.

3 credits, Letter graded (A, A-, B+, etc.)

EST 576: Geographic Information Systems in Education and Research

Students use Geographic Information Systems (GIS) software to create, manipulate and interpret layers of interactive maps and databases. Students collect and modify geographical materials from the Internet, satellite and aerial imagery, and field data. They design and test scientific inquiry-driven educational modules and/or visualizations for research and analysis on global and local geography, for use in economics, earth science, politics and civic action, history and sociology,
EST 577: Environmental Information Systems (EIS)
Due to the complex nature of environmental and spatial data, these systems require state-of-the-art computer technology to achieve environmental science and information technology. This course will address the technical and conceptual bases of data capture, data storage, data analysis and decision support, and metadata management. This course will address the technical and conceptual bases of data capture, data storage, data analysis and decision support, and metadata management. Environmental Information Systems are concerned with the management of data about the rock of soil, the water, the air, and the species around us. Spring, 3 credits, Letter graded (A, A-, B+, etc.)

May be repeated for credit.

EST 578: Human-Computer Interaction Design for Construction
Principles of human-computer interaction applied to the design of educational courseware. Usability engineering, with a focus on the audience and learning objectives. Interface design principles. Human computer dialogues. Multimedia as a communication tool, using images, audio and video. Multimodal input devices and strategies. Students will use a multimedia authoring tool to create a prototype of an educational application or learning tool. 3 credits, Letter graded (A, A-, B+, etc.)

EST 579: Educational Games
Simulations and computer games as a learning tool. Traditional game and simulation genres, and their appropriate uses in education. Gameplay design. Game development process, from storyboarding to delivery. Assessing games as learning tools. Students will use a multimedia tool to prototype an educational game or simulation of their own design. 3 credits, Letter graded (A, A-, B+, etc.)

EST 580: Advanced Technology Assessment: Business, Government and Strategy
This course has a two-fold objective: (1) to help students develop strong conceptual foundations for understanding and addressing issues at the intersection of science, technology, public policy, and business strategy; and (2) to provide students with knowledge of analytical frameworks and tools that are essential to technology assessment in business, government, and government, and other organizations with understanding of their strengths, limitations, and underlying assumptions. Topics covered include utility/profit maximization theory, its limitations and alternative theories, business and government interactions, technology innovation and management, technology forecasting, impact assessment, technology valuation, and basic tools for technology assessment (monitoring, simulation, expert opinion, scenario analysis, cost-benefit analysis, AHP method, etc.). Summer, 3 credits, Letter graded (A, A-, B+, etc.)

EST 581: Decision-making in Technology Settings
Complex problems (choices) need to be resolved in the course of socio-technical processes. Quantitative decision-making techniques have been evolved to address these situations. We will investigate a number of these techniques in detail, in order to understand the advantages that can be gained by using them. We will also discuss common criticisms and issues associated with these methods, and consider the heuristic methods that are often used instead to resolve complicated problems. 3 credits, Letter graded (A, A-, B+, etc.)

EST 582: Socio-Technological Systems
Systems thinking requires changing perspectives as to how to analyze problems and seek solutions. Socio-technical systems are the more complicated kinds of systems that require integrating knowledge of technologies with human elements. We will examine common concepts used to analyze systems, including a number of conceptual approaches to modeling systems. The course is qualitative not quantitative in its approach. 3 credits, Letter graded (A, A-, B+, etc.)

EST 583: National Energy Decision Making
The course approaches Energy Decision Making through a wide perspective of countries, cities, corporations, facilities and homes. The course will provide tools to analyze the energy use for different entities including governments, corporations and individuals. It will provide a framework to analyze both the choices and constraints of sources and uses of energy. The course is a practical overview of techniques and processes useful for people who will have decision-making responsibilities for energy systems in policy, business or engineering domains. 3 credits, Letter graded (A, A-, B+, etc.)

EST 585: Assessment of Technology in Learning Environments
This course is designed to provide educators with an overview of the uses of technology to improve instruction. Students will understand the design and function of learning environments, individual applications related to the student's area of professional practice, and assessment of educational uses of technology today and tomorrow. Students will chose a current technology used in a specific learning environment and analyze and evaluate its effectiveness within instruction including practical classroom use and staff development for the particular technology. Students will then research and make recommendations on how the particular technology could be integrated most effectively to increase teacher understanding and enhance student learning. Students then present their findings about the current use of the chosen technology, possible improvements on its use as well as future technology recommendations. Fall, Spring, and Summer, 3 credits, Letter graded (A, A-, B+, etc.)

EST 590: Seminar for MS, TSM Students
How can practitioners avoid fads or impressions and instead use reliable evidence from multiple sources to understand ¿big questions¿ in Science, Technology and Society Studies (STS)? This course is designed to help you understand and use a scientific, analytic approach to review and summarize a body of knowledge in STS. You will identify an STS question of personal interest and/or career relevance. You will then conduct a review of the scholarly literature on that topic, draw conclusions, and write a research report. In sum, through this course you will access, evaluate, and use empirical research to evaluate and inform your understanding of an STS ¿big question¿. In this way, you and your seminar colleagues will have an opportunity to learn both about chosen topics in depth, and more generally to learn to be savvier consumers of research. 3 credits, Letter graded (A, A-, B+, etc.)

May be repeated for credit.

EST 591: Independent Study in Technology and Society
The primary objective of independent study is to provide a student with opportunities to interact with faculty members who can be of assistance in his or her master's project. Students should consult individually with faculty members on workload and credit(s). 1-3 credits, Letter graded (A, A-, B+, etc.)
The ample supply and appropriate use of energy is critical to the well being of human society. Energy plays an enormous role in environmental degradation, national insecurity, international conflict, and in solutions to these problems. This course aims to introduce the major energy issues to students in engineering, business, and public policy areas. It discusses the energy choices to meet regional and global energy needs. Major renewable and conventional energy sources, energy supply technologies, and end-use efficiency options will be assessed in the context of political, social, economic, and environmental goals.
3 credits, Letter graded (A, A-, B+, etc.)

EST 593: Risk Assessment and Hazard Management
An introduction to the methods and techniques for assessing and managing risks to humans and the environment from natural and technological hazards. The course consists of lectures and readings on risk assessment and hazard management and discussions of published case studies. Students will conduct their own case studies and present them in oral and written reports.
3 credits, Letter graded (A, A-, B+, etc.)

EST 594: Diagnosis of Environmental Disputes
Diagnosis of disagreements about environmental and waste problems. Tools for evaluating disputes about (a) scientific theories and environmental models, (b) definitions and analytical methodologies for estimating risk, "real" cost, net energy use, and lifecycle environmental impact, (c) regulatory and legal policy, (d) siting of controversial environmental facilities, and (e) fairness and other ethical issues. These diagnostic tools are brought to bear upon case studies of pollution prevention, recycling, nuclear waste disposal, and climate change.
3 credits, Letter graded (A, A-, B+, etc.)

EST 595: Principles of Environmental Systems Analysis
This course is intended for students interested in learning systems engineering principles relevant to solving environmental and waste management problems. Concepts include compartmental models, state variables, optimization, and numerical and analytical solutions to differential equations.
Prerequisites: MAT 132 and one year of quantitative science such as physics, chemistry, or geology; or permission of instructor. Offered as EST 595 or HPH 688.
Fall, 3 credits, Letter graded (A, A-, B+, etc.)

EST 597: Waste Management: Systems and Principles
3 credits, Letter graded (A, A-, B+, etc.)

EST 598: Master's Project in Technology and Society
This course requires direct supervision by a member of DTS faculty. Students work independently to complete their master's project. Students typically address the MS project in three ways: 1) a literature search on a technical area relating to their concentration; 2) a project that combines content from two or more course; 3) a work related problem that requires additional technical information or training. Note: These credits cannot be counted as part of the 30 credits required for the degree.
S/U grading
May be repeated for credit.

EST 599: Special Projects and Topics
A technology assessment laboratory for emerging problems and focused research. May be run as a hands-on, group research study of an important educational, environmental or waste problem (perhaps to provide an assessment to a regulatory agency or administrative system). 1-12 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

EST 600: Technology, Policy, and Innovation: Theory and Practice
This course provides students with frameworks and models for analysis of issues at the intersection of science, technology and public policy, and business strategy; and helps students develop skills to work on policy issues that require deep understanding of the technical details. Topics include utility/profit maximization theory, its limitations and alternative theories, business and government interactions, technology innovation and management, policy process (agenda setting, problem definition, framing the terms of debate, formulation and analysis of options, evaluation of policy outcomes). Cases drawn from energy and environmental policy, educational technology. STEM education will be used to illustrate stakeholders and their value structures, high levels of uncertainty, multiple levels of complexity, and their influence on policy intervention. This course emphasizes quantitative policy analysis methods, and critical thinking.
Spring, 3 credits, Letter graded (A, A-, B+, etc.)

EST 601: Grand Challenges in Energy and Environmental Policy
The survey course will be taught by the faculty of Technology and Society and provide an introduction to the major energy and environmental issues of our time. The course will take an interdisciplinary perspective drawing from policy, engineering, social and physical sciences, the course will cover challenges and opportunities related to society's demand for energy and resources, and resulting environmental impacts. It is a required course for all elective for all PhD candidates and advanced Masters students outside of the energy and environmental program who may take the course with the permission of the senior faculty member responsible for the course. The course will be conducted in a mixture of lecture and seminar styles. An extensive reading list will be provided on each issue. Responsible Instructors: Gerald Stokes Co-instructors: Elizabeth Hewitt, Gang He
3 credits, Letter graded (A, A-, B+, etc.)

EST 602: Energy, Technology and Society: Energy Nexus Research Frontiers
Energy is at the center of the nexus challenges-energy, water, food, land, environment and development-that human being faces, critical linkages between those issues demand system integrative thinking and of growing interest in research and policy communities. This course will provide a deep working knowledge, technically and socially, of the energy technologies, policies, and transition. This course will survey the energy nexus concepts and principles, introduce tools of analysis, and engage students in case studies of critical energy nexus issues: energy and development, energy and water, energy and food, energy and land, energy and environment, and energy and climate change. This course aims to explore the frontier of energy nexus research and empower students to contribute in the energy nexus debate and policy design.
Spring, 3 credits, Letter graded (A, A-, B+, etc.)

EST 603: Energy Systems Analysis
This class offers a systems analysis approach and introduces useful modeling tools to capture and reveal the complexity of energy systems. The scope of this class includes main forms of energy, major energy production, conversion, and consumption activities, and technology innovation and transition embedded in the energy systems. We will first discuss the theoretical and empirical knowledge base and data sources to understand the energy-environmental and climate problems. The class will then introduce the modeling tools and skills to analyze energy systems or individual energy projects so as to understand energy systems and enable evidence-based decision making. This class encourages students to design research projects, using the modeling tools, and presenting results.

3 credits, Letter graded (A, A-, B+, etc.)

**EST 604: Grand Challenges in English, Education, Management & Policy**

New technologies are created by and for people. In this course, we examine how that happens or fails to happen. We will examine policies at the organizational, community, sectoral, national, and cross-national levels and how they influence the lives and work of the many and varied people who create, use, benefit from, and suffer from new technologies. We will cover six grand challenges in engineering education, management and policy (EEMP): Educating wisely with technology (i.e., effectively and efficiently); Ensuring equity; Sparking and sustaining innovation; Managing, organizing, and leading engineering enterprises; Harnessing the power of emerging technologies; and Coexisting with technology to maximize rewards and minimize risks (i.e., our individual and collective health, well-being, and happiness).

3 credits, Letter graded (A, A-, B+, etc.)

**EST 605: Economics and Public Policy**

This course focuses on theoretical economic concepts and their planning and policy applications, and it is structured as an introductory-level survey of economics. This course covers foundations of microeconomics including supply & demand, elasticity, market efficiency, externalities, and public goods. We then expand to key concepts in environmental economics, urban economics, and macroeconomics, and will discuss recent challenges to neoclassical economic theory, such as behavioral economics. Importantly, the connection to policy implementation and practical societal challenges will be heavily stressed.

3 credits, Letter graded (A, A-, B+, etc.)

**EST 606: The Economics of Technology, Policy, and Innovation**

This course is the second in a two part economics sequence that applies the tools from Part 1 to evaluate sectors of the economy related to technology, public goods, and innovation. Readings cover the literature related to the cross between public economics and technology / innovation. Policies related to technology and innovation enhancements will be assessed using the criteria of effectiveness, efficiency, equity, economic growth, and economic stability. How technology and innovation impact the economy and industry, how well advances are being implemented, will all be examined from the economist’s perspective. Pre-req: EST 605, Economics and Public Policy with a grade of C+ or better Fall semester. 3 credits, A, B, C, F.

3 credits, Letter graded (A, A-, B+, etc.)

**EST 607: Energy and Environmental Economics and Markets**

The landscape of global energy markets over the past decades has largely been driven by economics and regulations. This course will draw the theories and tools of economics and regulations to study the evolution of the energy and environmental markets and the policy implications of such evolution. This course will examine the development of effect of organized energy markets, the industry structure and evolution of competition in the energy and environmental markets, the political economy of regulation and deregulation, market power and antitrust, climate change and environmental policy and their impacts in energy and environmental markets. This course will also discuss the emerging markets for clean energy, energy efficiency, and transport and storage of energy. This course aims at analyzing the rationale for and effects of public policies in energy and environmental markets.

Spring, 3 credits, Letter graded (A, A-, B+, etc.)

**EST 610: Data Analysis for Technology, Policy and Innovation**

This course covers many of the common empirical tools used for research in Technology, Policy, and Innovation. Topics include: descriptive statistics, clustering, discrimination analysis, estimation, hypothesis testing, and regression analysis. To learn these topics, students will use modern statistical software programs to analyze data sets with socio-technological applications. After this course, students will have the tools to conduct robust data analyses and present the work in written and visually appealing formats.

This course assumes that students have basic knowledge of statistics or data analysis. 3 credits, Letter graded (A, A-, B+, etc.)

**EST 620: Decision Making in Socio-Technological and Global Contexts**

Methodologies and applications to enhance students’ abilities to use qualitative and quantitative approaches to examine decision problems within socio-technological and global contexts. Psychological, social, and cultural influences on decision making in organizations. Power and limitations of the theories, models and tools of decision analysis. Applications to decision problems in a variety of areas, including energy and environmental systems, educational technology, and education in science and engineering, technology management, and science and technology policy.

3 credits, Letter graded (A, A-, B+, etc.)

**EST 625: Advanced Theory and Practice in Technology and Policy**

Technology change entails more than the commercialization of an invention. Likewise, policy making encompasses much more than cost-benefit analysis and regulation. This advanced, graduate level course examines critical theory for both subjects by drawing on ideas from systems and science, policy and management, economics, and STS. Emphasis is placed on deconstructing theoretical applications in the context of policy-based problem-solving and innovation objectives. Topics will include policy cycles, regulatory capture, innovation systems, dimensions of technology change, and lock-in, among others. Students will develop skills to work in roles at the interface of technology and management.

3 credits, Letter graded (A, A-, B+, etc.)

**EST 650: Directed Study**

Individual studies under the guidance of a faculty member. Subject matter varies according to the needs of the student. May be repeated for credit.

1-9 credits, Letter graded (A, A-, B+, etc.) May be repeated for credit.

**EST 660: Teaching, Learning, and Technology**

A professional development seminar that is designed to help Ph.D. students develop the competencies needed to become effective teachers in colleges and universities. Students will learn relevant teaching and learning theories and their applications to teaching courses and laboratory sessions. Students will learn methods for the design and assessment of courses, including courses that integrate...
appropriate technologies to enhance learning and teaching. Students will learn how to create learning environments that build on the strengths and address the varied needs of a diversity of learners.

Restricted to Ph.D. students registered in the Certificate Program on College Teaching. Fall and Spring, 0-3 credits, Letter graded (A, A-, B+, etc.)

**EST 688: Internship in Research**

Participation in private corporations, public agencies, or non-profit institutions. Students will be required to have a faculty coordinator as well as a contact in the outside organization to participate with them in regular consultations on the project, and to submit a final report to both. At most one credit can be accepted toward the degree. 1-3 credits, S/U grading May be repeated for credit.

**EST 690: Seminar in Theory Building**

Science is about discovering facts as well as explaining what the facts mean. Theories provide explanations and interpretations of empirical phenomena and building and modifying theories are at the heart of core scientific activities. Good theory is essential to many new fields for several reasons. First, good theory provides guidance for practical action and therefore should be at the foundation of curricula. Second, without good theory in any particular field, researchers must borrow theories from other academic disciplines. While this can be useful, sometimes these theories might not fit our subject matter well. For example social theories based on behavioral assumptions stemming from non-digital communications do not fully address substantive features of social behavior in a digital age. Research courses commonly emphasize empirical research methods and formal modeling approaches to theory development. There is much less guidance for those who want to build a theory for managerial and behavioral studies-Yet every researcher must do so to develop a good research proposal. This seminar aims to fill that gap by focusing on theory types and evaluation criteria, theory development processes, and theoretical writing. Offered in Spring, 3 credits, Letter graded (A, A-, B+, etc.)

**EST 691: Seminar on Innovation, Invention, and Diffusion**

Innovation is viewed as central to progress for any individual, organization, nation or global effort. In this seminar we will discuss invention, the two main phases of innovation, exploration and exploitation, the notion of diffusion of innovation and finally innovation policy as well as policy innovation. We will explore a number of types of innovation including radical versus incremental, technological versus administrative, product versus process and more. Using relevant case studies and selected readings from the most influential voices on innovation, including those in academia, corporate America as well as policy-making organizations, we will explore the many different sides of innovation, why it is one of the most critical issues of our time and how seminar participants can contribute to overall innovative efforts. Offered Fall, 3 credits, Letter graded (A, A-, B+, etc.)

**EST 692: Research Seminar**

This seminar is a forum for the discussion of research methods, project ideas, proposal preparation and the written and presentation of research proposals and results. It is designed to meet the needs of early career researchers at both the Masters and Ph.D. level. For Masters students, final product of this seminar is an approved masters project proposal. Ph.D. students will present progress on their own research. All students will participate in peer review of each others’ work and learn the basics of the responsible conduct of research. 1-3 credits, Letter graded (A, A-, B+, etc.) May be repeated for credit.

**EST 694: Energy and Buildings & Technology, Policy, and Behavior**

Buildings consume vast amounts of energy and resources, and are one of the largest contributors to greenhouse gas emissions. Major advances in building design and technology over the past decade have given us tools to make buildings more energy efficient, but buildings lag far behind their potential. There are many avenues to green the built environment sector, including technological innovations, occupant behavior programs, retrofits of existing buildings, and innovative building codes. Ultimately, reducing energy consumption in the building stock will require an interdisciplinary approach and some combination of a range of program and policy types. This course will introduce students to the many interdisciplinary issues surrounding energy use in buildings, with a particular focus on the intersection of policy with technology, economics, social science, and behavior. The course will combine lectures, student-led discussions, guest speaker(s) and field trip(s) to green buildings, depending on scheduling. 3 credits, Letter graded (A, A-, B+, etc.)

**EST 695: Topics in Technology, Policy, and Innovation**

Topics selected on the basis of the needs of the graduate program and research interests of the staff. 0-3 credits, Letter graded (A, A-, B+, etc.) May be repeated for credit.

**EST 696: Advanced Topics in Technology, Policy and Innovation**

Advanced topics selected on the basis of the needs of the graduate program and research interests of the staff. 1-3 credits, Letter graded (A, A-, B+, etc.) May be repeated for credit.

**EST 697: Directed Study**

Individual studies under the guidance of a faculty member. Subject matter varies according to the needs of the student. 1-9 credits, Letter graded (A, A-, B+, etc.) May be repeated for credit.

**EST 698: Practicum in Teaching**

This course enables graduate students to gain experience in teaching and interacting with students enrolled in Technology, Policy, and Innovation courses. Students enrolled in EST 698 are expected to perform various teaching duties required by the course instructor, such as attending lectures, providing office hours, holding review/recitation session, proctoring exams, grading, etc...

Fall, Spring, and Summer, 1-3 credits, S/U grading May be repeated for credit.

**EST 699: Dissertation Research on Campus**

Dissertation research under direction of advisor. 1-9 credits, S/U grading May be repeated for credit.

**EST 700: Dissertation Research Off Campus - Domestic**

Prerequisite: Must be advanced to candidacy (G%). Major portion of research will take place off-campus, but in the United States and/or U.S. provinces. Please note, Brookhaven National Labs and Cold Spring Harbor Lab are considered on-campus. All international students must enroll in one of the graduate student insurance plans and should be advised by an International Advisor.

1-9 credits, S/U grading May be repeated for credit.

**EST 701: Dissertation Research Off Campus - International**

Prerequisite: Must be advanced to candidacy (G5). Major portion of research will take place outside of the United States and/or
U.S. provinces. Domestic students have the option of the health plan and may also enroll in MEDEX. International students who are in their home country are not covered by mandatory health plan and must contact the Insurance Office for the insurance charge to be removed. International students who are not in their home country are charged for the mandatory health insurance. If they are to be covered by another insurance plan they must file a waiver by the second week of classes. The charge will only be removed if other plan is deemed comparable. All international students must receive clearance from an International Advisor. May be repeated for credit. Offered every semester, 1-9 credits, S/U Grading

1-9 credits, S/U grading
May be repeated for credit.

EST 800: Summer Research
May be repeated for credit.

EUR European Studies

EUR 501: Historical and Cultural Frameworks of Europe

Intended as a General Introduction to European Civilization and Cultures, this course begins with the "idea" of Europe and traces how it developed over the course of 25 centuries. Through the juxtaposition of historical, philosophical and creative texts, as well as images, it will cover key points from ancient Middle-Eastern and Mediterranean cultures through the Middle Ages and the Early Modern period, examine various social, religious, political and artistic configurations through the XIX and XX centuries, and end with the creation of the European Union. Approaches may vary from the philosophical to the artistic/literary, from the socioeconomic to the political.

Fall & Spring, 3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

EUR 502: Methods of Research and Theories of Interpretation

An introduction to research techniques in philology and manuscript retrieval, including an acquaintance with major libraries and collections throughout Europe and the United States. This includes basic digital humanities research techniques. Students will also be introduced to the major currents of criticism in literature, history and philosophy, including the basic concepts of structuralism, Marxism, reception aesthetics, historiography, and hermeneutics. Students will be required first to locate, identify, and describe certain texts, and then to analyze them according to the given theories of interpretation. 3 credits. ABCF grading.

3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

EUR 503: Perceptions and Inventions of Europe

This seminar will focus on the problematic of how Europe dealt with the rest of the world, taken mainly in a historical perspective, and stressing different aspects of the relation. The running thread is represented by the triple topics of contact, conflict, and exchange, using various types of travelers, such as explorers, geographers and merchants, as the starting points, but extending it scholars, artists, emigrants and exiles. Course will also look at how non-Europeans first met, described, and reacted to Europeans. Several media used. 3 credits. ABCF grading.

3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

EUR 504: European Arts, Poetics, Culture

The aim of this course is to make an in-depth critical assessment of the signal contribution of French, German, Italian and British thinkers and artists to two major turning points: Romanticism and Postmodernism, debates which raged in Europe (and by reflection the US), the first from the 1790s through the 1830s, the second from the post-World War Two period through the late Nineties. Among the topics: the nature, ideologies and structure of the attack on traditional (i.e.: Enlightenment, and/or Modernist) modes of thought and organization; the theories and methods proposed in turn; and implications for literary theory, education, politics and history; the evolving features of selected works of art 3 credits. ABCF grading. May be repeated for credit if syllabus or instructor is different.

3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

EUR 571: Special Topics In European Studies

Course will focus on the imaginative construction of other worlds as a critique of or alternative to the existing one in specific moments of Europe's social and cultural development. Each utopian project manifests striking different stylistic, social, symbolic and philosophical takes on what the different authors conceive as an alternative to Europe's complex history. Actual texts may vary depending on Instructor, and different mediums may be used.

3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

EUR 581: Independent Individual Studies

Studies in specialized topics under the direction of a designated faculty. Fall, Spring or Summer, 1-6 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

EUR 599: Thesis Research

Research and writing of MA Thesis supervised by faculty advisor.
Fall, Spring, or Summer, 3-6 credits, S/U grading
May be repeated for credit.

FIN Finance

FIN 524: Asset Pricing

This course will give students an overview of asset pricing theory, estimating asset pricing models, pricing options and other derivatives. Topics covered will include Consumption-Based Pricing Model and Discount Factors; Mean-Variance Frontier and Beta Presentations; Factor Pricing Models(Capital Asset pricing Models and Arbitrage Pricing Theory); Speciﬁcation
Modern investment and traditional approaches to investment valuation, selection and management. Modern investment theory, including asset pricing models and efficient market hypotheses are explained. Traditional approaches to stock and bond selection, including fundamental analysis and technical analysis, will be explained in detail.

Investment management strategies for both individual and institutional investors will be developed and discussed. Prerequisite: MBA 502 or FIN MS or 36 credit MBA in Finance

3 credits, Letter graded (A, A-, B+, etc.)

FIN 540: Probability and Statistics for Finance

A survey of probability theory and statistical techniques with applications to finance situations. Topics covered include regression; binomial, Poisson, normal, exponential, and chi square random variables; tests of hypotheses; confidence intervals; tests; and analysis of risk, variance, regression, and contingency tables. Prerequisite: MBA 502 or FIN MS or 36 credit MBA in Finance Student

3 credits, Letter graded (A, A-, B+, etc.)

May be repeated 1 times FOR credit.

FIN 541: Bank Management

The goal of the course is to introduce students to the banking industry and develop skills necessary to effectively manage a financial institution. Students will learn how to analyze bank performance, liquidity, and capital adequacy. Students will also learn how to measure various financial risks associated with financial intermediation, and how to manage those risks using asset-liability management techniques, financial derivatives, and other hedging tools. Prerequisite: MBA 502 or Admission to the MS in Finance or 36 credit MBA in Finance

3 credits, Letter graded (A, A-, B+, etc.)

FIN 547: Fundamentals of Fixed Income Analysis

A concrete understanding of the fundamentals of fixed income security analysis. Study of the basics of bond analysis, such as the relationship between the price and yield of a bond, the sensitivity of a bond's price to changes in yield, and measuring the total return on a bond. We will analyze the determinants of interest rates and how different market participants interact. Trading strategies, evaluate their risk, and perform ex-post analyses will be discussed. Prerequisite: MBA 502 or 36 credit MBA in Finance Student

3 credits, Letter graded (A, A-, B+, etc.)

FIN 549: Risk Management

This course focuses on mathematical and statistical methods to measure financial risk and to hedge the risk using derivatives. Students study simulation methods to measure risk, numerical methods for portfolio optimization, and hedge the portfolio risk using futures and options. They will apply the stochastic process model with time-varying volatility to the risk management. Students will have a critical view of the classical market model and study various alternative probability models to capture the "black swan" event of the financial market. Finally, students will have an opportunity to develop their own risk management system using numerical software developing tools with current market data. Prerequisite: Co-requisite MBA 502 or Admission to the MS in Finance or 36 credit MBA in Finance

3 credits, Letter graded (A, A-, B+, etc.)

FIN 552: Mergers & Acquisitions

This course focuses on hands-on insights into the practice of corporate value creation in the form of mergers and acquisitions (M&As). The techniques and methodologies to be developed to effectively understand corporate valuation and make effective M&A decisions on the buy-side or on the sell-side are the discounted cash flow valuation, comparable companies, analysis, precedent transactions analysis, and leverage buyout (LBO) analyses and techniques. At the center of this course is to build financial modeling skills through extensive use of Excel program, which will require integrating specialized knowledge of various valuation methodologies, leveraged debt capital markets, corporate recapitalization and restructuring into mergers and acquisitions context.

Prerequisite: MBA 502 or Admission to the MS in Finance or 36 credit MBA in Finance

3 credits, Letter graded (A, A-, B+, etc.)
FIN 562: Data Analysis for Finance
Recent innovation of information technology along with the fast growth of applications on the Internet have resulted in an explosion of financial data, new ways of data collection and storage, as well as additional opportunities for business and research based on the data. This course enables students to analyze financial data based on traditional financial models. The major topics include asset pricing, capital budgeting, risk management, pension fund management, portfolio analysis, and stock hedging. Students will learn (review) the models with a focus on their implementation using Microsoft Excel, Matlab, or other programming languages. In addition, the basic statistical models, such as regression, time series models and probability models will be used. Big Data, (data mining) technology will be introduced with a focus on financial data analysis. The main topics include classification, clustering, association analysis and anomaly detection. The key objectives of this course are: (1) to review the classical financial models and statistical models; (2) to teach the concepts of data mining with a focus on financial applications; (3) to provide students extensive hands-on experience in applying the concepts in financial data applications. Prerequisite: MBA 502 or 36 credit MBA in Finance and completion of MBA 502, 1 credit, S/U grading.

FIN 576: Real Estate Finance
This course is not a lesson on how to get rich quick in real estate with no money down. It will be a study of the major aspects of real estate finance, user decision making and investment from the perspective of corporate, private, and public owners; investors; and users. Commercial properties will be emphasized. The course begins with an overview of the fundamentals of commercial real estate and builds on these concepts as we consider the forces that influence the cyclical, fragmented, and inherently local business of real estate. These foundation concepts are further considered in detail in a series of four case studies that will be completed by the students and discussed in class by the instructor. The course will expose students to current real world, real estate finance, user decision making and investment situations. The course is case-based, and students will be challenged to think on their feet in class. Students will have the opportunity to develop their business presentation skills through case discussions and project presentations. Prerequisite: MBA 502 or 36 credit MBA in Finance Student 3 credits, Letter graded (A, A-, B+, etc.)

FIN 578: Behavioral & Social Finance
This course studies the concepts, evidence, and applications of behavioral and social finance theories to understand and improve individual and managerial financial decision-making and the outcomes for firms and markets. Topics include investors¿ wants, cognitive and emotional heuristics and errors, behavioral portfolio construction, nudging personal finance management, impacts of investor psychology and social interactions on financial markets, professional ethics, values and socially responsible investing, ESG, etc. The course integrates financial analysis and financial planning with Excel and coding using programs like Python. Prerequisite: Co-requisite MBA 502 or Admission to the MS in Finance or 36 credit MBA in Finance 3 credits, Letter graded (A, A-, B+, etc.)

FIN 580: Financial Modeling
This course focuses on performing a research project related to current issues in the financial market. Students are requested to make and join a group project. The topics of the research project must be related to quantitative analysis in finance, and the results must be quantitatively verified. To do this, probability models, time series models, stochastic process models, and simulation methods can be applied. To solve a complex system problem, students may need to use parallel computing, cloud computing, machine learning, and artificial intelligence. Solutions are necessary to be implemented by advanced programming languages, for instance Matlab, R, Python, Java, or C++. Prerequisite: Admission to the MS in Finance and completion of MBA 502, FIN 540, FIN 539, and FIN 541 3 credits, Letter graded (A, A-, B+, etc.)

FLA 507: Critical Pedagogy
This graduate seminar is intended to introduce the ideas, theories, and practices that together constitute the field known as critical pedagogy. Critical pedagogy assembles numerous forms of academic approaches to teaching and curriculum that are informed by critical social theory. As the educational arm of critical social theory, critical pedagogy engages educators in understanding the relationships among knowledge, ideology, and power. We will read works from several critical pedagogy theorists (Freire, Shor, Giroux, McClaren, Apple, hooks) to explore some of the key themes within critical pedagogy (relationship of education to power; issues of difference and pluralism; transformative education; the social construction of knowledge; dialogic relations in the classroom; teaching for social justice). Learning through collaborative inquiry, we will translate the theories in these readings into practice and will test ideas and concepts unique to teaching and learning "critical (second/foreign) language" in a school setting. 3 credits, Letter graded (A, A-, B+, etc.)

FLA 549: Field Experience
Observation, inquiry, and practice in foreign language education at the secondary level including 50 hours of documented visitations and observations at approved sites. Field experience writing logs are the basis of group discussion. S/U grading.
1 credit, S/U grading

FLA 550: Field Experience
Observation, inquiry, and practice in foreign language education at the secondary level including 50 hours of documented visitations and observations at approved sites. Field experience writing logs are the basis of group discussion. S/U grading.
1 credit, S/U grading

FLA 551: Supervised Student Teaching
7-9
FLA 552: Supervised Student Teaching
10-12

FLA 554: Student Teaching Seminar
Seminar on instructional planning and assessment in World Languages, grades 7-12, aligned with current state, national, and professional standards. Focus is on delivering proficiency-based instruction and meeting the needs of diverse learners. Variable credits (1-3 credits)
1-3 credits, Letter graded (A, A-, B+, etc.)

FLA 570: Introduction to Media for Language Teaching
Course open to non-D.A. students. Gives students an introduction to all of the technology used in teaching languages; audio, video, computer, and Internet. Emphasis is on hands-on use and practical applications. Fall or spring
3 credits, Letter graded (A, A-, B+, etc.)

FLA 571: Foreign Language Technology and Education
Course open to non-D.A. graduate students. Assumes knowledge of material taught in DLL/FLA 570. Addresses more globally and more theoretically the intersection between technology and languages. Issues of cognitive learning theory and educational psychology addressed. Offered as DLL 571 and FLA 571 Prerequisites: FLA 505 and FLA 506
Fall or Spring, 3 credits, Letter graded (A, A-, B+, etc.)

FLA 581: Foreign Lang Teach Project (Ind. Study)
Students enrolled in Track B of the MA program in European Languages (French, German, Italian or Russian) or the MA in Hispanic Languages complete an independent project in the area of Foreign Language Teaching. The content and scope of this project must be approved by the Director of Foreign Language Pedagogy. Possible projects include a fully developed professional teaching portfolio (in print and/or electronic version), an action research study or a classroom-based research study culminating in a publishable paper. Fall or spring
3 credits, Letter graded (A, A-, B+, etc.)
May be repeated 1 times FOR credit.

FLM

FLM 500: Introduction to Graduate Studies
This seminar course will introduce graduate film students to each other, to graduate faculty across disciplines, and will encourage new collaborations and projects for development during the students’ graduate careers. Film students will meet to discuss the role of each artist, with emphasis on the changing nature of collaboration and the expanding art form in today’s film profession. Readings, written assignments and collaborative projects are required. 4 credits. Letter graded (A, A-, B+, etc.) Prerequisite: Permission of the Instructor. Southhampton and Manhattan. Semesters Offered: Fall & Spring.
3-4 credits, Letter graded (A, A-, B+, etc.)

FLM 501: Film Tools
This course will give students an overview of production essentials; covering safety, basic movie-making equipment and basic editing. Student will spend time in the classroom and on set, shooting various exercises, paying special attention to set safety, proper handling of the gear, the ins and outs of a selection of cameras, sound equipment and lighting. In addition, the basics of cinematography and framing, audio techniques and basic set protocol will be covered. The course will cover the basics of non-linear editing; including: creating new projects, media management, sequence settings, importing, transcoding, sound, JKL cuts, titling, mixed file format editing, export settings and delivery.
3 credits, Letter graded (A, A-, B+, etc.)

FLM 505: Film Management I: Production Development
Instruction and training in art direction and design which may include exploration of a particular approach, review of current techniques, experiments in style, hands-on exercised, intensive production periods, etc. The particular theme of the course will be announced in the course schedule. Beneficial for writers, directors, and producers. Suitable for film and television.
1-3 credits, Letter graded (A, A-, B+, etc.)
May be repeated 2 times FOR credit.

FLM 506: Film Management II: Literary Management
In this course, students will be guided through a deeper dive examination of best-practices, a changing landscape, and strategies for marketing, distribution, financing, legal and post-production in film, television, & digital content. The class is structured as an independent study for students to workshop their ongoing individual projects and receive one-on-one mentoring from class instructors. Throughout the semester this course will also include provocative in-class conversations with working industry professionals such as producers, agents, lawyers, financiers, and distributors. This is a highly interactive and practical application class where students will work throughout the semester individually and collaboratively on building an executable plan for one film, tv, or digital content project of their choosing in preparation for its creation and release.
3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

FLM 508: Editing I
This course will focus on the editing process and how a film is shaped during editing. Tools of editing will be explored as well as the theory behind their use. Through film examples, articles, books and hands on lessons, students will learn the craft of editing. The language and purpose behind every cut will be examined. Working with cutting-edge digital editing software, the course will cover the basics of non-linear editing; including: creating new projects, media management, sequence settings, importing, transcoding, sound, JKL cuts, titling, mixed file format editing, export settings and delivery.
1-3 credits, Letter graded (A, A-, B+, etc.)

FLM 509: Cinematography I
This course will focus on the fundamentals of camera, sound, safety, and proper use of basic production equipment. Students will be introduced to the tools necessary to shoot their short films, shooting various exercises in a classroom and on the set, including safety, proper handling of the gear, the ins-and-outs of a selection of cameras, sound equipment and lighting. In addition we will cover the basics of cinematography and framing, audio techniques and basic set protocol. This is the first step to properly capturing the stories students have to tell. Course takes place in the classroom and on the set.
3 credits, Letter graded (A, A-, B+, etc.)

FLM 510: Film History I
Film as text in the context of its time. A study of Film History with attention to specific topics in the lexicon, theories, movements and genres of the field. It may be repeated as an independent study with the permission of the instructor. 3 credits, Letter graded (A, A-, B+, etc.) May be repeated for credit. Semesters Offered: Spring.
3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

FLM 520: Film History II
 Course surveys films of a specific period or movement. May be repeated once. 3 credits, Letter graded (A, A-, B+, etc.).

FLM 523: Film in New York
The course delves into a field survey of film and television offerings in New York City, festival by festival and organization by organization. Students will become acquainted with the status of film in New York, including, but not limited to The Film Society of Lincoln Center, The Tribeca Film Fest, New York Film Festival, New York Shorts Festival, IFC, Doc NYC, Women’s International Film Festival, New York Women in Film and Television, New York Mayors Office of Film and Television, New York Governor’s Office of Film and Television, and New York Production Alliance. Additionally, all students will serve as jurors on the SUNYWide Film Fest.

3 credits, Letter graded (A, A-, B+, etc.) May be repeated for credit.

FLM 525: Topics in Film
Intensive studies of selected forms of film and filmmaking from various countries and periods, designed to supplement rather than repeat areas of study already undertaken in the curriculum. Topics may include producing, directing, writing in film, the ins-and-outs of financing, genre screenwriting, films without words, films in the noir tradition, the spaghetti western, among others. May be repeated for credit. Prerequisite: Permission of instructor. 1-3 credits, Letter graded (A-, B+, etc.). Semesters Offered: Fall & Spring.

FLM 526: Topics in TV Writing
A seminar for writers and filmmakers concentrating on one area of study or topic in Television. The particular theme of the course will be announced in the course schedule. Topics may include, among others, the showrunner, producing the web series, international TV, producing the comedy sketch, a survey of American television. 1-4 credits, Letter graded (A, B, B+). May be repeated for credit.

FLM 530: Directed Readings in Film
Students read and evaluate the literature on a topic of special interest under the supervision of a faculty member. What makes a good script? What makes a producible script? What makes a feature film, a television series, a made-for-tv movie, or a webisode. May be repeated for credit. Prerequisite: Permission of instructor. 1-3 credits, Letter graded (A-, B+, etc.). Semesters Offered: Fall & Spring.

FLM 536: Forms of TV Writing
Regular submission, discussion, and analysis of students work in one or more contemporary areas of television writing. Topics may include writing for mini-series and limited-series, unscripted television, writing for documentary, writing for short form, writing the webisode, writing for international TV, writing the pilot, writing the spec, among others.

1-6 credits, Letter graded (A, A-, B+, etc.) May be repeated for credit.

FLM 537: Production I
In this course, writing, directing, editing and cinematography training will be synthesized, focused, and put into practice. Students work from the scripts developed in previous semester. In the first weeks, students review camera, sound, lighting, casting, scheduling, safety, and running a set. While preparing shot lists, story boards, call sheets, shooting schedules, talent agreements and location releases necessary to bring their visions to the screen. Then the production cycle begins: intense breakout sessions coupled with camera blocking prepare students for the rigors of a film shoot. To make the experience truly immersive, students crew on all productions, so expect to spend many days on set.

3 credits, Letter graded (A, A-, B+, etc.)

FLM 538: Writing TV
A seminar for writers of television dramas, mini-series and distribution; together with lectures, readings, seminars, and panels featuring nationally distinguished artists. These workshops encourage participation by visiting students, new theatre and film artists, established film artists, and teachers who will be admitted by application and may receive academic credit upon request. Graduate students may take any Film Workshop sponsored by the MFA program for academic credit. Study may occur in Southampton, Manhattan, or abroad. A submission of a workshop application, and permission of instructor are required. 1-6 Credits. Letter graded (A, A-, B+, etc.) May be repeated for credit. Semesters Offered: Fall & Spring.

FLM 550: Teaching Practicum
Supervised student teaching of undergraduate courses accompanied by a seminar in methods and strategies of teaching film at the University level. An independent teaching project, in which the student works with a particular faculty member, may be substituted. 3 credits, Letter graded (A, A-, B+, etc.). Southampton and Manhattan. Semesters Offered: Fall & Spring.

FLM 560: Acting Theory and Practice
Course surveys the field of acting-its history, formal principles, primary techniques, and contemporary practice. Students develop course papers and, or projects in conjunction with advanced readings and instruction.

Spring, alternate years, 3 credits, Letter graded (A, A-, B+, etc.) May be repeated for credit.

FLM 575: Adaptation Workshop
This course is an intense examination of a stage play, a work of fiction (novel, novella, short story, poem) or a work of non-fiction (memoir, autobiography, poem), with the object of preparing an adaptation for the screen. Valuable for writers, directors and producers. The course will study other text to screen adaptations and film versions. Students will submit an outline or rough draft of their new version at the end of the course. 3 credits, Letter graded (A, A-, B+, etc.). May be repeated for credit. Semesters Offered: Fall & Spring.

3 credits, Letter graded (A, A-, B+, etc.) May be repeated 1 times FOR credit.

FLM 576: Film Workshop
The workshops are intensive classes in various aspects of the craft of film, including producing, directing, editing, cinematography, lighting design, sound design, screenwriting, directing, acting, scheduling, budgeting, writing/directing webisodes, writing, producing and directing within the Dogme tradition, and episodic television, sitcoms, dramas, mini-series, and distribution; together with lectures, readings, seminars, and panels featuring nationally distinguished artists. These workshops encourage participation by visiting students, new theatre and film artists, established film artists, and teachers who will be admitted by application and may receive academic credit upon request. Graduate students may take any Film Workshop sponsored by the MFA program for academic credit. Study may occur in Southampton, Manhattan, or abroad. A submission of a workshop application, and permission of instructor are required. 1-6 Credits. Letter graded (A, A-, B+, etc.) May be repeated for credit. Semesters Offered: Fall, Spring. 1-6 credits, Letter graded (A, A-, B+).

May be repeated for credit.

FLM 591: Independent Project
Special project allowing advanced individual work in an area of film study or practice under the supervision of a faculty member. Must be scheduled by arrangement with instructor. Should result in longer form screenplay, production package or film, episode, or webisode. Can include technical, trade, or business school study.

1-3 credits, Letter graded (A, A-, B+, etc.) May be repeated for credit.

FLM 608: Editing II
Horror, comedy, drama and action. Four different genres, four different editing styles. This course will cover the styles used to edit the various film genres and why each
and every cut has a purpose. Focus on the tools of editing as well as editing theory. Through the analysis of film clips, class discussion, and hands on lessons, students will learn the fundamentals and the processes of reconstituting these styles. Working with editing software, students will have the opportunity to edit various scenes, which will range in style and tone. Student will learn to think critically about all aspects of filmmaking, including blocking, framing, locations and shot selection.

3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

**FLM 609: Cinematography II**

This course will introduce you to the advanced cinema tools at your disposal. We will spend time in the classroom and on set, shooting various exercises, utilizing a wide variety of advanced camera/lighting and grip equipment. In addition to on-set exercises, we will study a variety of current and former cinematographers, analyzing their work from film to film.

1-3 credits, Letter graded (A, A-, B+, etc.)

**FLM 637: Production II**

The primary goal of this flexible workshop is to foster students’ individual visions while expanding the scope of their production knowledge and experience. Participants should bring a draft of a 5-12 page script to the first class. Classes will focus on directors’ preparation—both creative and practical. For the shoots, students will choose their collaborators and run their own sets. The final weeks of the class will be preparation for Dogme shoots.

3 credits, Letter graded (A, A-, B+, etc.)
May be repeated 2 times FOR credit.

**FLM 638: Directing I - Principles of Directing**

This course will focus on the analytical organizational and creative processes necessary to be a director. Topics include: visualizing your story, storyboarding, scene construction, shooting to the turn in the scene, shot lists, shoot schedules, framing, composition, script analysis and interpretation; visual interpretation (narrative, evocative image) and working with art directors, set designers, wardrobe, sound and light designers; casting, and the actor / director process. Preparation, leadership, scheduling. Students will gain a practical, hands-on understanding of the topics covered through exercises, various directing assignments, and a final project. 3 credits, Letter graded (A, A-, B+, etc.).

3 credits, Letter graded (A, A-, B+, etc.)

**FLM 639: Directing II: Advanced Directing**

This course will build upon the work covered in Directing I and will focus on advanced problems in Directing, including advanced scene work, choreographing the action scene, directing within a style or period, directing with f/x, incorporating f/x into scenes, alternative forms, and the challenges of contemporary film and/or filmmaking. Topics may change. Prerequisite: THF 638 or permission of instructor. 3 credits. Letter graded (A, A-, B+, etc.).

3 credits, Letter graded (A, A-, B+, etc.)
May be repeated 1 times FOR credit.

**FLM 640: Film Design Workshop**

Advanced assignments in film design. May include understanding set design, sound design, light design, art direction, music supervision, and shooting within a style, period, genre, era. Prerequisite: Permission of instructor. 3 credits, Letter graded (A, A-B+, etc.)

3 credits, Letter graded (A, A-, B+, etc.)
May be repeated 2 times FOR credit.

**FLM 650: Screenwriting Workshop I**

Students write, discuss and receive feedback on writing exercises, original scenes, and short or full-length screenplays, teleplays, episodic television, sit coms, long form dramas or webisodes. Advanced students may develop material for production. Prerequisite: Permission of instructor. 3 credits, Letter graded (A, A-B+, etc.)

3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

**FLM 651: Screenwriting Workshop II**

Emphasis on a particular aspect or genre of screenwriting, including comedy, drama, noir, crime, dogme, period, action, writing within a high or low budget; character, dialogue, structure, and experimental forms. Emphasis also on workshopping whole drafts of longer form projects. Prerequisite: FLM 650 or permission of instructor. 3 credits. Letter graded (A, A-, B+, etc.)

3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

**FLM 652: Screenwriting Workshop III**

Advanced problems in writing of original screenplays for film, television, web and other media platforms. Emphasis on whole drafts and revision.

3-6 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

**FLM 660: Acting Workshop for Filmmakers**

Intensive study in acting in a particular approach or technique. Rehearsals outside of the scheduled class time may be required. Prerequisite: Permission of instructor. 3 credits, Letter graded (A, A-, B+, etc.). May be repeated for credit.

3 credits, Letter graded (A, A-, B+, etc.)
May be repeated 1 times FOR credit.

**FLM 669: Advanced Tools**

In this hands-on workshop course, students will focus on five specific areas of film making...Advanced Cinematography, Line Producing, Script Supervising, Production Design and Sound Design. Each class will be led by a working professional, and at the conclusion of this course students will emerge with a greater understanding of each discipline.

3 credits, Letter graded (A, A-, B+, etc.)

**FLM 670: Directing Workshop**

Advanced training in directing, which may involve intensive production periods, experiments in style, exploration of a particular technique and approach, such as day for night, etc. May be repeated once for credit. Prerequisite: Permission of Instructor.

3 credits, Letter graded (A, A-, B+, etc.)
May be repeated 2 times FOR credit.

**FLM 680: Art Direction Workshop**

Advanced training in directing, which may involve intensive production periods, experiments in style, exploration of a particular approach, review of current techniques, experiments in style, hands-on exercized, intensive production periods, etc. The particular theme of the course will be announced in the course schedule. Beneficial for writers, directors, and producers. Suitable for film and television.

3 credits, Letter graded (A, A-, B+, etc.)
May be repeated 1 times FOR credit.

**FLM 690: Professional Internship**

A full-term internship at a production company or on a production. Students identify a Film company or artist whose work interests them. The student is expected to articulate his/her goals, research companies and inquire about internship opportunities at those institutions. A faculty advisor may help point students in the right direction; but is incumbent upon the student to do the research and secure an internship. Students then present a written proposal to the faculty advisor for approval. Students will also submit an internship description in the first month of work, then a journal or evaluation of their work experience.
GRADUATE COURSE DESCRIPTIONS

Fall 2024

FRN 500: Techniques of Reading for Graduate Research
Through intensive study of language structures and idiomatic usage, with extensive practice in written translation of literary and scholarly texts, candidates for advanced degrees are able to attain the proficiency level of the graduate French reading requirement. Several departments grant exemption from further examination for successful completion of this course. (Not for graduate students in French.)

Fall or Spring, 1-3 credits, Letter graded (A, A-, B+, etc.)

FRN 501: Contemporary Culture and Civilization
Analysis of contemporary French civilization through the study of the development of its historical, cultural, political, and social characteristics. Designed for potential teachers of French at the college level as well as in secondary schools, this course will emphasize and trace the evolution of the character and institutions of contemporary France and French-speaking countries.

Fall or Spring, 3 credits, Letter graded (A, A-, B+, etc.)

FRN 502: French Civilization in Its Historical Perspective
In this course, students study historical French civilization concentrating on those features which have created France today and its current culture. Political and social developments are considered as well as major trends in the arts.

Spring, 3 credits, Letter graded (A, A-, B+, etc.)

FRN 507: Stylistics
Stylistic theory and analysis. Contrastive stylistics French/English. Exploration of the connotative level of written message. Designed to develop and refine written expression in French and analysis of literary and non-literary texts.

Fall or Spring, 3 credits, Letter graded (A, A-, B+, etc.)

FRN 510: Phonetics
The pronunciation of French with emphasis on intonation and articulation. Theory and practice of linguistic and phonetic factors of the sound system. Coursework includes phonetic transcriptions, oral and aural transcriptions, as well as pronunciation. The class is entirely conducted in French.

Fall or Spring, 3 credits, Letter graded (A, A-, B+, etc.)

FRN 511: Business French
A course designed to provide efficiency in spoken and written business French with an emphasis on bilingual translation. This course will also familiarize students with French business domestically, in the context of the European Union, and in contrast to America. Issues of current importance as well as institutions will be studied. Students will also carry on individual projects such as comparing marketing strategies of an American company in the US and in France or profiling a major French company.

3 credits, Letter graded (A, A-, B+, etc.)

FRN 513: Romance Linguistics
This course examines the linguistic evolution of the Romance languages from the classical period through modern times. The synchronic grammars of Italian, French, and Spanish are examined.

Fall or Spring, 3 credits, Letter graded (A, A-, B+, etc.)

FRN 531: Studies in 17th-Century French Literature
Analysis of some of the major literary genres of 17th-century French literature such as tragedy, and comedy, novels or poems, or focus on some of the major themes of 17th-century literature in general. Mme de Lafayette, La Rochefoucauld, La Bruyère, etc. The class is entirely conducted in French.

Fall or Spring, 3 credits, Letter graded (A, A-, B+, etc.)

FRN 532: Seminar in 17th-Century French Literature
Special topics in 17th-century French literature. Intensive reading and analysis of selected texts by authors such as Descartes, Pascal, La Fontaine, La Rochefoucauld, La Bruyère, Mme de Sevigné, and Mme de Lafayette, among others. Changing topic. The class is entirely conducted in French.

Fall or Spring, 3 credits, Letter graded (A, A-, B+, etc.)

FRN 541: Studies in 18th-Century French Literature
A study of the major texts of the 18th-century expressing the struggle between absolutism and the emerging forces of Enlightenment, preromanticism. It may include the works of Montesquieu, Voltaire, Diderot, Rousseau, Beaumarchais, and Laclos, among others, as well as the works of lesser-known authors who also helped reshape the literary scene during that time.

Fall or Spring, 3 credits, Letter graded (A, A-, B+, etc.)

FRN 542: Seminar in 18th-Century French Literature
Special topics in 18th-century literature, such as "Le roman initiatique," and "Eros in fiction," are studied through the works of major writers of the period as well as those of lesser-known figures, in particular women writers.

Fall or Spring, 3 credits, Letter graded (A, A-, B+, etc.)

FRN 552: Studies in 19th-Century French Literature
Close reading of selected works by major novelists of the period, such as Balzac, Stendhal, Flaubert, Zola; themes such as Paris versus the provinces, money and decadence; or 19th-century poetry by Baudelaire, Mallarme, Verlaine, and Rimbaud, with an introduction to some important critical approaches to these texts.

Fall or Spring, 3 credits, Letter graded (A, A-, B+, etc.)

FRN 561: Seminar in 20th-Century French Literature
Special attention to a literary trend, a movement of ideas, or a single author of the first half of the century. Topics are considered
in parallel with the political and social contexts, and with other artistic mediums such as cinema, painting, or photography. Possible topics: Avant-garde & Surrealism, Existentialist writers, War Literature, Marcel Proust, Jacques Prevert, etc.

FRN 562: Studies in 20th and 21st-Century Literatures
Focused examination of contemporary French literary texts and recent Francophone writings of Belgium and Switzerland. Questions may address the limits of fiction and representation in the novel, the status of modern theater and poetry, the new impact of visual and technological devices, human relationships in a global world.

Fall or Spring, 3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

FRN 564: Seminar in Francophone Literature
Close examination of the literatures written in French of the Francophone world outside of France. This course will pose and explore questions such as: What is Francophone literature? What is the function of writing in French in a Francophone context? Attention is paid to the issue of critical approaches to these texts. Topics vary from year to year and may include texts from any of the French-speaking territories outside of France.

Fall or Spring, 3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

FRN 570: Special Topics in French Literature
Courses given in the past have covered a single author, French women writers, French poetry of 1664-1674 and other topics.

3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

FRN 571: Free Seminars
Courses given in the past have covered a single author, genre, and other topics.

Fall or Spring, 3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

FRN 581: Independent Individual Studies
May be repeated for credit as the topic changes.

Prerequisite: must be enrolled in a graduate program.

FRN 582: OVERSEAS: GERMANY
May be repeated for credit.

FSY 540: Study Abroad
May be repeated for credit.

FSY 541: OVERSEAS KONSTANZ
May be repeated for credit.

FSY 542: OVERSEAS TUEBINGEN
May be repeated for credit.

FSY 543: OVERSEAS: ROME
May be repeated for credit.

FSY 544: OVERSEAS: PARIS
May be repeated for credit.

FRN 584: Overseas: Spain
May be repeated for credit.

FSY 594: OVERSEAS: ROME
May be repeated for credit.

FRN 595: Practicum in Teaching
Fall and Spring, 1-3 credits, S/U grading
May be repeated for credit.

FRN 599: Thesis Research
Fall and Spring, 1-3 credits, S/U grading
May be repeated for credit.

FRN 800: Summer Research
May be repeated for credit.

GEO 500: Geosciences Research Seminar
Meetings in which first-year graduate students and undergraduates with senior standing learn about the research activities of the Geosciences faculty.

Fall, S/U grading

GEO 502: GIS for Geologists
A practical introduction to geographic information system software. Participants learn to use direct measurement and mathematical techniques to compute the location of features and gain practical experience in rendering imagery and tabular geographic data as layers on maps. The course consists of two three-hour sessions per week for the first five weeks of the semester, which include fieldwork, lectures, demonstrations and software-based analysis of data.

This course meets with GEO 588 (Geological Field Methods for Earth Science Teachers) for the first five weeks of the semester. Students may not take GEO 502 and GEO 588 for credit.

Fall, 1 credit, Letter graded (A, A-, B+, etc.)

GEO 503: Mineral Equilibria
Covers the basics of the application of the principles of chemical thermodynamics to the resolution of geochemical and petrological problems. Begins with the first law and continues through phase transitions, properties of fluids, definitions of fugacity and activity of major and trace elements in fluids and molten solutions; configurational entropies; models quantifying nonideal mixing in solid solutions. Additional topics include interpretation of calorimetric studies and/or solubilities of minerals in aqueous solutions.

Prerequisites: Physical chemistry and thermodynamics, or permission of instructor Fall, alternate years, 3 credits, Letter graded (A, A-, B+, etc.)

GEO 504: Geology of the Turkana Basin
Students are introduced to the current perspectives on the origins and evolution of the Turkana Basin, Kenya. Students learn how to apply fundamental geological
concepts to the sediments and rock units to provide a foundation for the chronology and context for recorded events in human evolution. Emphasis is given to sedimentation, stratigraphy, volcanism, and tectonics, as they apply to local geology, including training in field methods. Modern terrestrial processes and landscape evolution are examined using features present in the Turkana Basin. Consideration is also given to broader geologic events spanning the Oligocene to the present. Geologic concepts are linked to modern and ancient environments, archaeology, and paleoanthropology in northern Kenya. It is a field-based course involving visits to important geological and fossil sites. Graded work includes fieldwork and lab assignments, independent research assignments, quizzes and a final exam. Semesters offered-Fall and Spring. Components- laboratory, lecture, and recitation.

3 credits, Letter graded (A, A-, B+, etc.)

GEO 505: Experimental Petrology Laboratory
The course is designed to give the student experience in some or all of the following techniques of experimental petrology: evacuated silica-glass tube experiments, one-atmosphere quenching experiments (with and without controlled atmospheres), 1- to 5- kbar hydrothermal systems (using oxygen buffers where necessary), gas-media experiments up to 7 kbar, and solid-media, piston-cylinder experiments.

Requirements: Completion of a project involving several of the above techniques; written report
Spring, alternate years, 1 credit, Letter graded (A, A-, B+, etc.)

GEO 506: Theoretical Petrology
Theory of phase diagrams, Schreinemaker's rules, heterogeneous equilibria, experimental systems of petrologic interest, and properties of solutions.

Prerequisites: Metamorphic and igneous petrology and physical chemistry or thermodynamics; or permission of instructor
Spring, 3 credits, Letter graded (A, A-, B+, etc.)

GEO 507: Petrogenesis
Discussion of the origin and evolutionary history of selected types of igneous and metamorphic rocks by integrating the principles of heterogeneous phase equilibria, trace-element and isotopic geochemistry, crystal chemistry, and geologic occurrence. The laboratory component, GEO 527, must be taken concurrently; a common grade for both courses will be assigned. Fall

3 credits, Letter graded (A, A-, B+, etc.)

GEO 508: The Rock-Forming Minerals
Study of the crystal chemistry, intracrystalline cation distribution (homogeneous equilibria) stability, and paragenesis of the rock-forming minerals. Special emphasis is placed on amphiboles, feldspars, micas, and pyroxenes.

Fall, 3 credits, Letter graded (A, A-, B+, etc.)

GEO 510: Dimensions of Global Change
This course is designed to be an intense study in global climate change science. The emphasis will be on modern climate change however, by studying the contributions of paleoclimatology we can gain insight into how the climate system operates. To understand modern climate change and predictions, it is necessary to develop an understanding of natural climate forcing, natural variability and feedbacks in the climate systems. Adding to natural variation are the impacts of anthropogenic forcing. The course will examine the measured and predicted consequences of these anthropogenic forcing.

Offered Fall and Summer, 3 credits, Letter graded (A, A-, B+, etc.)

GEO 511: Computer Programming for the Geosciences
An introduction to object-oriented programming in Java for geoscience students. Participants are required to develop interactive programs to serve as educational or research tools pertaining to topics within the geosciences. These programs, or applets, include a graphical user interface that enables users to control parameters and observe results. The applets are posted on the World Wide Web.

Prerequisite: Geosciences graduate standing
Spring, 3 credits, Letter graded (A, A-, B+, etc.)

GEO 512: Structure and Properties of Materials
An introductory course that will explore materials from the viewpoint of their structure and chemistry and how these affect applications. Different states of matter (crystals, quasicrystals, glasses, liquids) will be discussed and their similarities and differences, focusing on the crystalline state. Nanomaterials and their peculiarities in terms of structure and properties will also be considered. Particular attention will be paid to (1) Materials for energy and environment applications, (2) materials for technological applications, and (3) Earth and planet-forming materials.

3 credits, Letter graded (A, A-, B+, etc.)

GEO 513: GIS Fundamentals I
This course provides the basic concepts underlying modern geographic information science and technology. Emphasis is placed on the principles of GIS for collecting, storing, characterizing, and maintaining data and computer-based techniques for processing and analyzing spatial data. The course includes three hours of lecture, in class exercises and homework projects each week. This is a computer based class with the majority of students work involving GIS computer software. Prerequisite: working knowledge of spreadsheet software

3 credits, Letter graded (A, A-, B+, etc.)

May be repeated 1 times FOR credit.

GEO 514: Introduction to Physical Hydrogeology

Spring, 3 credits, Letter graded (A, A-, B+, etc.)

GEO 515: Geohydrology

Spring, 3 credits, Letter graded (A, A-, B+, etc.)

GEO 517: Crystal Chemistry
The structure/property/composition relationships in solids. An introduction to the common structure types and how they illustrate principles useful in understanding more complex solid-state materials. Applications of modern scattering techniques to the study of solids, particularly Earth materials, are also included.

Fall, 3 credits, Letter graded (A, A-, B+, etc.)

GEO 518: Carbonate Sediments
An intensive study of the formation, deposition, lithification, and diagenesis of carbonate sediments. Lectures and seminars emphasize principles of carbonate deposition, facies relationships, and chemistry. Laboratories emphasize binocular and petrographic analysis of recent and ancient carbonates.
GRADUATE COURSE DESCRIPTIONS

Spring, alternate years, 4 credits, Letter graded (A, A-, B+, etc.)

GEO 519: Geochemistry of Natural Waters
A comprehensive quantitative treatment of the processes controlling the chemistry of polluted and unpolluted surface and groundwaters. Topics covered include thermodynamics and kinetics of water-rock interaction; mineral solubility; chemical speciation; redox reactions; adsorptions; carbonate chemistry; and speciation, mobility, and toxicity of metal ions. Based on a knowledge of these processes, the chemical composition of a wide variety of surface and groundwaters is interpreted. Water-quality criteria and their application are also discussed.

Spring, 3 credits, Letter graded (A, A-, B+, etc.)

GEO 520: Glacial Geology
History of glaciation on earth, formation and dynamics of glaciers and ice sheets; processes of glacial erosion and deposition; and the nature of glacial sediments and landforms particularly relating to the development of Long Island.

Prerequisite: Physical Geology

Spring, 3 credits, Letter graded (A, A-, B+, etc.)

GEO 521: Isotope and Trace Element Geology
Application of radiogenic isotopes and trace elements to the petrogenesis of igneous, metamorphic, and sedimentary systems including water-rock interaction in diagenetic and hydrothermal systems. Evaluation of radiogenic techniques for determining the ages of rocks and minerals.

Spring, alternate years, 3 credits, Letter graded (A, A-, B+, etc.)

GEO 522: Planetary Sciences
The chemical, physical, and petrologic properties of meteorites are reviewed. These data and data for the moon and the terrestrial planets are used to form a picture of the origin, chemical evolution, and accretion of planetary material.

Fall, 3 credits, Letter graded (A, A-, B+, etc.)

GEO 523: Geodatabase and Design
Concepts of geodatabase design and management in geographic information systems (GIS), SQL statements, geographic data types and functions, data entry, and techniques of geographic information structure applications.

3 credits, Letter graded (A, A-, B+, etc.)

May be repeated for credit.

GEO 524: Organic Contaminant Hydrology
There are a host of chemical, biological, and physical processes that affect the transport and fate of organic chemicals in natural waters. This course concerns understanding these processes and the structure-activity relationships available for predicting their rates. The major focus of this class is on contaminant hydrology of soil and aquifer environments, and includes the principles behind remediation and containment technologies. This course is offered as both MAR 524 and GEO 524.

Prerequisite: GEO 526 or MAR 503 or permission of instructor

Spring, 3 credits, Letter graded (A, A-, B+, etc.)

GEO 525: GIS Fundamentals II
GIS Fundamentals II will introduce the applied use of Geographic Information Systems (GIS) which is now used extensively in analytical studies. The course emphasizes the applications of GIS in solving real-world problems. Students are expected to gain an understanding of GIS theory, methodology and most importantly application. Students are also expected to demonstrate abilities of spatial thinking, spatial analysis, and be able to solve practical spatial problems utilizing a GIS.

3 credits, Letter graded (A, A-, B+, etc.)

May be repeated for credit.

GEO 526: Low-Temperature Geochemistry
Fundamental principles of chemical thermodynamics and kinetics, including isotope effects, as they pertain to geochemical processes occurring in surface and near-surface environments. Consideration is also given to mass transfer process and reaction pathways.

Fall, 3 credits, Letter graded (A, A-, B+, etc.)

GEO 527: Petrogenesis Laboratory
Three hours of laboratory per week that corresponds to the content of GEO 507 1 credit, Letter graded (A, A-, B+, etc.)

GEO 528: Carbonate Geochemistry
Examination of the mineralogical and chemical characteristics of the rock-forming carbonates with emphasis on stabilities in the geological environments. Includes study of phase relations; trace and minor element chemistries; and mechanisms of growth, dissolution, and replacement. Use of current research techniques as applied to carbonate minerals.

3 credits, Letter graded (A, A-, B+, etc.)

Fall, alternate years, 3 credits, Letter graded (A, A-, B+, etc.)

GEO 530: The Geology of Mars
Overview of Mars as a planetary system. Evolution of the planet and its atmosphere through time. Detailed discussion of processes that have shaped the martian surface, including erosion, sedimentation, volcanism, impact cratering, physical and chemical weathering. Comparison of geologic processes on Mars and Earth. Discussion of past and future spacecraft missions to Mars. Three hours of lecture per week.

3 credits, Letter graded (A, A-, B+, etc.)

GEO 531: Crystalline Solids
Principles of symmetry, single-crystal, and powder X-ray diffraction techniques and elements of crystal structure determination are considered. Use of crystallographic data in the study of mineral systems. Laboratory in diffraction techniques includes extensive use of digital computers.

Fall, alternate years, 3 credits, Letter graded (A, A-, B+, etc.)

GEO 532: Solid-State Geochemistry
The application of crystallographic techniques to problems in mineral chemistry. Concepts of the crystalline state, order-disorder, atom radii, chemical bonding, atom coordination, solid solutions, and physical properties of minerals. Emphasis on silicate and sulfide crystal structures.

Fall, alternate years, 3 credits, Letter graded (A, A-, B+, etc.)

GEO 533: Geochemistry of the Terrestrial Planets
A brief overview of basic principles of geochemistry, including origin of the elements, geochemical and cosmochemical classification of the elements, and a geochemical perspective of the periodic table. This is followed by an examination of the compositions and chemical interactions among the major geochemical reservoirs of the terrestrial planets, including their cores, mantles, crusts, and where relevant, sedimentary shells.

Fall, alternate years, 3 credits, Letter graded (A, A-, B+, etc.)

GEO 534: Concepts in Geomorphology
Study of landforms and the processes that produce and modify them. Discussion and practice of field, laboratory, and remote sensing methods used to assess landscape evolution.

3 credits, Letter graded (A, A-, B+, etc.)
GEO 535: Regional Structure and Tectonics
Formation and development of continental crust in Phanerozoic mountain belts. The structure and origin of ocean crust, magmatic arcs, and continental margin sequences are studied using geophysical, geochemical, and geologic data from ancient and modern examples.
Fall, alternate years, 3 credits, Letter graded (A, A-, B+, etc.)

GEO 540: Solid Earth Geophysics
An overview of solid earth geophysics. Topics include earthquake and exploratory seismology, gravity, magnetics, geochronology, and heat flow. There is an emphasis on how all of these techniques shed light on the nature of the Earth's interior and dynamics.
Prerequisite: Physical geology, undergraduate physics and calculus
Fall, 3 credits, Letter graded (A, A-, B+, etc.)

GEO 542: Inverse Theory and Machine Learning in Earth Science
Introduction to inverse theory and machine learning and their uses in solving various geological problems, with an emphasis on coding using python and related tools 3 credits, Letter graded (A, A-, B+, etc.)
3 credits, Letter graded (A, A-, B+, etc.)

GEO 543: Stratigraphy
The history and practice of defining units layered rocks and interpreting their spatial relationships. Topics include the basis for the geologic time scale, lithostratigraphic versus chronostratigraphic units, biostratigraphy, magnetostratigraphy, facies patterns and Walther's law, subsurface stratigraphy, and the application of stratigraphy to geological problems. The laboratory component, GEO 563, must be taken concurrently; a common grade for both courses will be assigned. Spring Prerequisite: GEO 546 or undergraduate mineralogy and petrology
3 credits, Letter graded (A, A-, B+, etc.)

GEO 546: Mineralogy and Petrology
An introduction to mineralogy and petrology, including crystallography, crystal chemistry, mineral identification, and the processes that govern the formation of igneous and metamorphic rocks. Three hours of lecture per week. The laboratory component, GEO 566, must be taken concurrently; a common grade for both courses will be assigned. Spring Prerequisite: Undergraduate physical geology and one year of undergraduate chemistry
3 credits, Letter graded (A, A-, B+, etc.)

GEO 547: Remote Sensing in Geosciences
Comprehensive study of commonly used image analysis methods in earth, environmental and planetary sciences. Discussion of physical principles that are the basis for remote sensing techniques. Participants gain practical experience in geologic and environmental problem-solving using satellite imagery.
Spring, 3 credits, Letter graded (A, A-, B+, etc.)

GEO 549: Structural Geology
Principles of structural geology, including the recognition and the mechanics of structural features. Topics include folding and faulting, stress and strain, and the nature of brittle and ductile lineations and foliations in the crust. Three hours of lecture per week. The laboratory component, GEO 569, must be taken concurrently; a common grade for both courses will be assigned. Spring Prerequisite: Undergraduate physical geology
3 credits, Letter graded (A, A-, B+, etc.)

GEO 550: Global Tectonics
Spring, 3 credits, Letter graded (A, A-, B+, etc.)

GEO 551: Physics of the Earth I
Study of the internal structure and properties of the Earth as revealed by field and laboratory investigations. Topics include the rotation and figure of the Earth, gravity anomalies, solid-earth tides, geomagnetism and paleomagnetism, electromagnetic induction, and heat flow and the Earth's present and past thermal states. May be taken independently of GEO 552.
Fall, 3 credits, Letter graded (A, A-, B+, etc.)

GEO 552: Physics of the Earth II
Study of the Earth's structure and properties based on evidence from seismology and high-pressure geophysics. Topics include fundamental principles of elastic wave theory, body and surface wave propagation in layered media, earthquake source mechanisms, free oscillations of the Earth, and rheological properties of the Earth's interior. May be taken independently of GEO 551.
Fall, alternate years, 3 credits, Letter graded (A, A-, B+, etc.)

GEO 556: Solid-State Geophysics
Application of lattice dynamics and equations of state of solids to studies in high-pressure, high-temperature geophysics. Reviews experimental data from physical acoustics, static and shock wave compression, and theoretical results from finite strain and atomistic models.
Prerequisites: GEO 551 and 552, or permission of instructor
Spring, 3 credits, Letter graded (A, A-, B+, etc.)

GEO 562: Early Diagenesis of Marine Sediments
The course treats qualitative and quantitative aspects of the early diagenesis of sediments. Topics include diffusion and adsorption of dissolved species; organic matter decomposition and storage; and diagenesis of clay materials, sulfur compounds, and calcium carbonates. The effects of bioturbation on sediment diagenesis are also discussed. This course is offered as both MAR 562 and GEO 562.
Fall, alternate years, 3 credits, Letter graded (A, A-, B+, etc.)

GEO 563: Stratigraphy Laboratory
Three hours of laboratory per week that corresponds to the content of GEO 543. Laboratory work emphasizes practical techniques in stratigraphy.
1 credit, Letter graded (A, A-, B+, etc.)

GEO 566: Mineralogy and Petrology Laboratory
Three hours of laboratory per week that corresponds to the content of GEO 546
1 credit, Letter graded (A, A-, B+, etc.)

GEO 567: Sedimentary Rocks and Crustal Evolution
An examination of major and trace elements and isotopic composition of terrigenous sedimentary rocks within a framework of tracing the composition and evolution of the continental crust. Emphasis is placed on interpreting sedimentary compositions in terms of provenance and sedimentary history (e.g., weathering, diagenesis, recycling). Relationships between sediment composition and tectonic setting is also examined.
Spring, 3 credits, Letter graded (A, A-, B+, etc.)

GEO 569: Structural Geology Laboratory
Three hours of laboratory per week that corresponds to the content of GEO 549
1 credit, Letter graded (A, A-, B+, etc.)
GEO 570: Earthquake Mechanics  
A survey of fundamental mechanics aspects of earthquake rupture; reviews concepts of fracture mechanics, elastodynamics, and experimental rock mechanics. Topics include state of stress in the lithosphere, theoretical models of earthquake instability, energetics of faulting, representation of dynamic elastic field generated by earthquakes, and relation of seismic signals to the kinematics and dynamics of seismic source.  
Prerequisites: GEO 552 or permission of instructor  
Spring, alternate years, 3 credits, Letter graded (A, A-, B+, etc.)

GEO 571: Mechanics of Geologic Materials  
Elastic, thermal, and anelastic properties of geological materials. The course emphasizes a thermodynamic characterization of these properties including irreversible thermodynamics and nonhydrostatic thermodynamics. Specific applications to the Earth's environment are discussed.  
Prerequisites: GEO 551, 552, or permission of instructor  
Spring, alternate years, 3 credits, Letter graded (A, A-, B+, etc.)

GEO 572: Advanced Seismology  
Course is intended to expose the student to topics that are at the forefront of current seismological research. Examples include wave propagation in heterogeneous media, earthquake source studies, tsunami generation, and seismic network data analysis.  
Prerequisite: GEO 552  
Fall, alternate years, 3 credits, Letter graded (A, A-, B+, etc.)

GEO 573: Physics of Rocks  
Fundamentals of the physical properties of rock in relation to seismology, hydrogeology, geophysical prospecting and geotechnical engineering. Topics include: composition, pore structure and fabric of rocks; elasticity, anelasticity and plasticity; seismic velocity and anisotropy; poroelasticity; electrical, magnetic and hydraulic transpost properties.  
Fall, alternate years, 3 credits, Letter graded (A, A-, B+, etc.)

GEO 581: Coastal Engineering Geology  
Concepts of the mechanics of earth materials and the physics of surficial processes with applications to the coastal environment and engineering. This course is also offered as mar 581.
Independent research for Ph.D. degree. Open only to candidates for the Ph.D. who have passed the preliminary examination.

Prerequisite: Advancement to candidacy (G5). Major portion of research will take place off-campus, but in the United States and/or U.S. provinces. Please note, Brookhaven National Labs and the Cold Spring Harbor Lab are considered on-campus. All international students must enroll in one of the graduate student insurance plans and should be advised by an International Advisor.

Fall, Spring, 1-9 credits, S/U grading
May be repeated for credit.

GEO 700: Dissertation Research off Campus - Domestic
Prerequisite: Must be advanced to candidacy (G5). Major portion of research will take place outside of the United States and/or U.S. provinces. Domestic students have the option of the health plan and may also enroll in MEDEX. International students who are in their home country are not covered by mandatory health plan and must contact the Insurance Office for the insurance charge to be removed. International students who are not in their home country are charged for the mandatory health insurance. If they are to be covered by another insurance plan they must file a waiver be second week of classes. The charge will only be removed if other plan is deemed comparable.

All international students must received clearance from an International Advisor.
Fall, Spring, 1-9 credits, S/U grading
May be repeated for credit.

GEO 701: Dissertation Research off Campus - International
Prerequisite: Must be advanced to candidacy (G5). Major portion of research will take place outside of the United States and/or U.S. provinces. Domestic students have the option of the health plan and may also enroll in MEDEX. International students who are in their home country are not covered by mandatory health plan and must contact the Insurance Office for the insurance charge to be removed. International students who are not in their home country are charged for the mandatory health insurance. If they are to be covered by another insurance plan they must file a waiver be second week of classes. The charge will only be removed if other plan is deemed comparable.

All international students must received clearance from an International Advisor.
Fall, Spring, 1-9 credits, S/U grading
May be repeated for credit.

GEO 800: SUMMER RESEARCH
May be repeated for credit.

GER 500: Intensive Reading German
This course is designed for graduate students in other programs to understand German prose. Students learn the basic structures of German grammar, acquire general and specialized vocabulary, and translate a variety of texts, including some from their academic areas of interest. In certain programs, successful completion of this course satisfies a language requirement, while in others it serves as preparation for their own foreign-language exam or testing procedure.

Fall and Spring, 1-3 credits, Letter graded (A, A-, B+, etc.)

May be repeated for credit.

GER 506: Advanced Stylistics
Advanced stylistics and discourse analysis. Designed to deepen the advanced student’s knowledge of the syntax, structure, and stylistic versatility of the German language.

Spring, 3 credits, Letter graded (A, A-, B+, etc.)

GER 539: Contrastive Structures: German-English
Contrastive study of the phonological, morphological, syntactic, and semantic structures of German and English.

Fall, 3 credits, Letter graded (A, A-, B+, etc.)

GER 541: Literature of the Goethe Period
A study of the literature and culture of Germany during Goethe’s lifetime, 1749-1832.

Spring, 3 credits, Letter graded (A, A-, B+, etc.)

GER 544: German Fiction
Major authors of modern German fiction are read and discussed. Texts many include works from 19th and 20th century authors. The course may also focus on works by a single author.

3 credits, Letter graded (A, A-, B+, etc.)

GER 545: 20th-Century German Poetry
Intensive reading and discussion of 20th-century German poetry, including works by Rilke, Trakl, Brecht, Benn, and Kirsch. The course may also focus on a single poet or movement in the 20th century.

Spring, 3 credits, Letter graded (A, A-, B+, etc.)

GER 546: 20th-Century German Drama
A survey of representative plays of the 20th century, including works by Hauptmann, Hofmannsthal, Kaiser, Sternheim, Toller, Fleisser, Horvath, and Brecht. The course may also focus on the works of a single dramatist.

Fall, 3 credits, Letter graded (A, A-, B+, etc.)

GER 547: Special Author Studies Tutorial

Fall and Spring, 3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

GER 548: Special Period Studies Tutorial

Fall and Spring, 3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

GER 557: History of the German Language
Proceeding from several characteristics of language in general and from the position of German within the Indo-European language family, this course addresses: the periodization of German language history; internal developments from Indo-European to modern German; the most important cultural events on the path of German from the tribal dialects to a unified language; and relations of borrowing between German and other languages. Texts from the different periods are examined for their linguistic features as well as for content.

3 credits, Letter graded (A, A-, B+, etc.)

GER 558: Middle High German
An introduction to Middle High German grammar with representative reading from the Middle High German classics.

Fall, 3 credits, Letter graded (A, A-, B+, etc.)

GER 562: Historical Germanic Linguistics
An introduction to the principles and methods of historical linguistics as applied to problems in the Germanic branch of Indo-European (early tribal movements, attempts at dialect grouping, dialect geography, etc.). Part of the course will be devoted to readings in Gothic, Old Norse, and Old High German with a comparison of the morphologies of these languages.

Spring, 3 credits, Letter graded (A, A-, B+, etc.)

GER 581: Independent Study
May be repeated for credit.

GER 591: Language Acquisition I
Elementary German I intended for graduate students from other programs.

1-4 credits, Letter graded (A, A-, B+, etc.)

GER 592: Language Acquisition II
Elementary German II intended for graduate students from other programs.

1-4 credits, Letter graded (A, A-, B+, etc.)

GER 593: Language Acquisition III
Intermediate and Advanced German intended for graduate students from other programs. The requirements for the course will include a graduate-level component to be determined by the instructor. May be repeated for credit.

GRD 510 engages Master’s and doctoral students in the PhD Career Ladder Program, a peer-led framework for career exploration and preparation. Graduate students follow seven career development steps which correspond to the essential components of an Individual Development Plan (IDP). The steps include: self-assessment, career research, informational interviewing, skill identification and building, CV/resume crafting, networking, and goal setting. Each section is led by a graduate student peer leader. Students will cultivate their career preparedness and gain a framework that they can apply to any career goal, academic and non-academic, now and in the future. By the end of the course, students will have gained increased confidence in and preparation for seeking a career of interest and will have a set of actionable goals for next steps.

GRD 595: Practicum in Teaching
Fall and Spring, 1-3 credits, S/U grading
May be repeated for credit.

GRD 599: Thesis Research
May be repeated for credit.

GRD 600: Rigor and Reproducibility in Research
A key backbone of the scientific method is the reproducibility of experimental observations. This means that results obtained by a specific study should be observed again if the experiment is repeated by the same or other researchers. Rigor in research is essential to ensure the reproducibility of results, as it results in the application of research methods that are robust and exclude bias. This course provides an overview of the general problems associated with ensuring research rigor and the reproducibility of results. Brief focused lectures are followed by in person, field-specific small group discussions and activities to facilitate discussions between faculty and students. Three sessions address issues of research rigor that are relevant across disciplines. Two additional sessions highlight issues specific to research in the biomedical sciences.

GRD 697: Fundamentals of College Teaching
This 10-week online course is an introduction to fundamental college teaching strategies applicable to many disciplines and careers. The first six weeks are asynchronous and self-paced, with two required modules and then a choice of two additional modules with content related to key topics in college teaching such as inclusive pedagogy, effective assessment, classroom management, and teaching online. The remaining 4 weeks are discussion-based with the option of two synchronous Zoom discussions or asynchronous VoiceThread discussions matched to asynchronous module topics, with the opportunity to share advice and teaching experiences with other graduate students as well as pose solutions to common scenarios you may encounter in college teaching. Assignments are short written reflections, multiple choice quizzes, and either Zoom or VoiceThread discussion participation.

GRD 700: Masters Completion
Intended for international masters students that will complete all degree requirements and graduate during a summer or winter semester. This course is intended to help satisfy immigration requirements. All international students are advised to speak with one of the International Advisors prior to enrollment to ensure compliance with all immigration requirements.

GRD 550: CEAS Placeholder
Placeholder course for students in special programs in CEAS. Specific programs designated by course topic.

GRD 520: Introduction to Science Policy for STEM
Science, technology and innovation (STI) are ubiquitous part of life and we must understand these concepts in order to develop effective policies. This 1 credit hour course is designed to teach engineering and science graduated students the main concepts in science, technology and innovation policy.

GRD 500: Responsible Conduct of Research and Scholarship
This course is designed to introduce students to the major issues in the ethics of research and scholarship. Using a combination of readings - written and web-based - videos, lectures, case discussion and other exercises, students will investigate the moral values intrinsic to research/scholarship/creative activity in their discipline and the professional and social values with which members of the discipline must comply. Each class will begin with an introductory lecture or video followed by discipline-based, small group discussions with the participation of faculty from the department or program from which the graduate students come.

GRD 509: Digital Cartography
Geospatial Science

GRD 510: Career Exploration with PhD Career Ladder Program

GRG 595: Digital Cartography
Maps portray spatial relationships among selected phenomena of interest and increasingly are used for analysis and synthesis. Cartography is the knowledge associated with the art, science, and technology of maps. Digital computer cartography still follows the same fundamental principles and still requires a broad understanding of graphicacy as a language (as well as numeracy and literacy). This course will provide an introduction to cartographic principles, concepts, software and hardware necessary to produce good maps, especially in the context (and limitations) of geographic information systems (GIS).

3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

GSS 513: GIS Fundamentals I
This course provides the basic concepts underlying modern geographic information science and technology. Emphasis is placed on the principles of GIS for collecting, storing, characterizing, and maintaining data and computer-based techniques for processing and analyzing spatial data. The course includes three hours of lecture, in class exercises and homework projects each week. This is a computer based class with the majority of students work involving GIS computer software. Prerequisite: working knowledge of spreadsheet software

3 credits, Letter graded (A, A-, B+, etc.)
May be repeated 1 times FOR credit.

GSS 517: Geospatial Narratives: Deep Mapping for Humanities and Social Sciences
Building on formal methods in qualitative reasoning, spatial and temporal representation and geospatial science, this course will explore state-of-the-art methods for humanities and social sciences students to visualize and drill down data. Hands-on exercises of deep mapping will cover how to collect, analyze and visualize quantitative and qualitative data, spatial data, images, video, audio, and other representations of places and artifacts in humanities and social sciences. This course will also discuss models of reasoning about events, actions and changes that are spatially contextualized. Only GSS517 or GSS513/ GEO513 will count the Graduate Certificate.

3 credits, Letter graded (A, A-, B+, etc.)

GSS 523: Geodatabase and Design
Concepts of geodatabase design and management in geographic information systems (GIS), SQL statements, geographic data types and functions, data entry, and techniques of geographic information structure applications.

3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

GSS 525: GIS Fundamentals II
GIS Fundamentals II will introduce the applied use of Geographic Information Systems (GIS) which is now used extensively in analytical studies. The course emphasizes the applications of GIS in solving real-world problems. Students are expected to gain an understanding of GIS theory, methodology and most importantly application. Students are also expected to demonstrate abilities of spatial thinking, spatial analysis, and be able to solve practical spatial problems utilizing a GIS.

3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

GSS 526: GIS Project Management
This course will enable students to addresses issues unique to a GIS operation such as: identify implementation issues for a GIS project or program; be prepared to assist in decision making procedures that involve management; incorporate strategies for success in your workplace; understand some of the legal issues about the use of GIS data; and be aware of the GIS industry outlook for employment and education.

3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

GSS 550: Applied Spatial Analysis
The specific focus is on spatial data analysis, such as the analysis of autocorrelation, principles of geostatistics and analysis methods that are relevant in the fields of public health, environmental/earth science and social science. An important aspect of the course is to gain hands-on experience in applying these techniques with GIS and spatial analytical software, and essential methodological and practical issues that are involved in sophisticated spatial analyses. 3 credits.

3 credits, Letter graded (A, A-, B+, etc.)

GSS 554: Geospatial Science for the Coastal Zone
The use of spatial data is becoming increasingly critical in the decision management process and planning of the coastal zone. This course will use GIS and Remote sensing tools to collect and analyze data for intergrading into the management, planning, and monitoring of the coastal geomorphology and ecosystems. Offered in Fall.

3 credits, Letter graded (A, A-, B+, etc.)

GSS 555: GIS and Remote Sensing
This course provides a basic overview of the technology by which aircraft and satellite data are produced and utilized in analyses to answer questions within a geographic context. Students will learn to identify sources of remotely sensed imagery appropriate for common applications; acquire, manipulate, and interpret aerial photographs and satellite imagery/data; and incorporate remote sensing data into Geographic Information Systems.

3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

GSS 570: Geospatial Narratives: Deep Mapping for Humanities and Sciences
Course will present special interest topics or recent software enhancements in the rapidly developing field of Geospatial Science. The course will include a mixture of core geospatial techniques and recently released methodology. Course will include a diversity of Geospatial topics including discipline specific topics relevant to majors in physical sciences, social sciences, business and engineering.

1-3 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

GSS 575: Geospatial Teaching Practicum
The teaching practicum provides teaching experience, carried out under faculty supervision. Student will work with a faculty member as assistant in a regularly scheduled course and student will be assigned a specific role to assist in teaching the course. The student will meet with the instructor on a regular basis to discuss intellectual and pedagogical matters relating to the course.

0-3 credits, S/U grading
May be repeated 3 times FOR credit.

GSS 587: Geospatial Research
This course is intended to provide graduate students in the Geospatial Science program an opportunity to obtain research experience. A written report is required. Prerequisite: Permission of instructor 1-3 credits. Letter graded (A, A-, B+, etc.)

1-3 credits, Letter graded (A, A-, B+, etc.)
May be repeated 1 times FOR credit.

GSS 588: GIS Internship
The GIS Internship is designed to provide students experience in the real workplace. Interns are expected to function as a GIS professional and work within the existing host facility structure or on a free standing project. Interns will complete assigned tasks by hosting professional and work within the existing host facility structure or on a free standing project.

1-3 credits, Letter graded (A, A-, B+, etc.)
May be repeated 3 times FOR credit.
GIS facility duties. These activities will be monitored by both a representative of the host facility and the instructor.
3 credits, Letter graded (A, A-, B+, etc.) May be repeated for credit.

**HAD**

**Clinical Laboratory Sciences**

**HAD 506: Clinical Cytogenetics Internship**
Introduces the students to clinical cytogenetic techniques and standard operating procedures utilized in a clinical cytogenetic laboratory. Permission of department is required. Prerequisites: Admission to Undergraduate CLS Program; HAD 406; Program Consent Required 3-5 credits, May be repeated 2 times FOR credit.

**HAD 590: Independent Study/ Clinical Laboratory Sciences**
Proposals for special projects in clinical laboratory sciences must be submitted to the program director for approval prior to registration. Prerequisites: Admission to Undergraduate CLS Program; Program Consent Required 1-6 credits, May be repeated 3 times FOR credit.

**HAL**

**Athletic Training**

**HAL 510: Strength and Conditioning for the Healthcare Practitioner**
Designed to provide a comprehensive overview of strength and conditioning for the future or practicing healthcare practitioner. Emphasizes exercise sciences (including anatomy, exercise physiology, and biomechanics), nutrition, exercise technique, program design, organization, administration, testing, and evaluation. Prepares students for nationally-accredited Certified Strength and Conditioning Specialist (CSCS) certification exam. Open to non-SHTM students Prerequisite: ANP 300, HAN 200 or Equivalent Anatomy Course; Instructor Consent Required 3 credits,

**HAL 515: Foundations of Athletic Training**
Introduces the student to athletic training and the role of the athletic trainer. Topics include the historical development of the profession, concept of the sports medicine team, and injury documentation. Emphasizes strategies for injury prevention, assessment, and treatment. Focuses instruction on the recognition and management of medical emergencies, training and conditioning techniques, and the fabrication and application of taping, wrapping, supportive, and protective devices.
4 credits,

**HAL 520: Principles of Physical Agents**
Introduces the use of therapeutic interventions to manage a variety of musculoskeletal conditions. Emphasizes an evidence-based practice approach to making sound clinical decisions for the use of therapeutic modalities. Topics include tissue response to injury, pain physiology, psychological response to injury, and therapeutic interventions for inflammatory and non-inflammatory conditions.
3 credits,

**HAL 525: Evidence Based Practice**
Introduces concepts of evidence based practice (EBP) in athletic training. The student will learn how to obtain, process, examine, and appraise peer reviewed journal articles. The students will become a consumer of literature and form a foundation for clinical practice as well as identifying areas of interest for future research projects through literature searches and round table discussions of literature.
1 credit,

**HAL 530: Critical Care**
This course will enable the student to evaluate and manage patients with acute conditions, including triaging conditions that are life threatening or otherwise emergent across all systems of the body. Students are required to have current certification in Basic Life Support CPR.
4 credits,

**HAL 535: Clinical Diagnosis & Treatment I**
Focuses on the principles of clinical diagnosis and treatment of orthopedic injuries to the lower extremity. Emphasizes the components of the comprehensive orthopedic clinical evaluation and diagnosis including history, inspection, palpation, functional testing, special evaluation techniques, and the establishment and implementation of therapeutic interventions.
5 credits,

**HAL 540: Clin Diagnosis & Treatment II**
Focuses on the principles of clinical diagnosis and treatment of orthopedic injuries of the head, cervical spine, and upper extremity. Emphasizes the components of a comprehensive orthopedic clinical evaluation and diagnosis including history, inspection, palpation, functional testing, special evaluation techniques, and the establishment and implementation of therapeutic interventions. Prerequisite: Year 1 Summer Courses 5 credits,

**HAL 545: Clin Diagnosis & Treatment III**
Focuses on the principles of clinical diagnosis and treatment of orthopedic injuries of the thoracic and lumbosacral spine. Emphasizes the components of a comprehensive orthopedic clinical evaluation and diagnosis including history, inspection, palpation, functional testing, special evaluation techniques, and the establishment and implementation of therapeutic interventions. Prerequisite: Year 1 Fall Courses 3 credits,

**HAL 550: Advanced Therapeutic Interventions**
Progression of previously learned therapeutic interventions. Emphasizes the use of therapeutic exercise and manual therapy techniques in order to rehabilitate patients from both surgical and non-surgical orthopedic conditions. Prerequisite: Year 1 Spring Courses 5 credits,

**HAL 555: Healthcare Management for Athletic Training**
Provides students with the ability to analyze various issues, policies, and procedures encompassing the ethical administration of athletic training in a managed-care model. Includes US federal healthcare laws, legal liability, issues, personnel management, facility organization and design, equipment maintenance, budgeting, record keeping, health care services, informatics, counseling, and public relations. Exposes students to principles that enhance their networking, professional development, and personal branding skills. Prerequisite: Year 1 Spring Courses 3 credits,

**HAL 560: Nutrition And Supplement Use for Sport Performance**
Provides an understanding of basic nutrition science as well as the use of supplements to enhance athletic performance. Students will become familiar with the principles of diet planning, food labeling, biological functions and food sources of primary nutrients, energy balance, weight management

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and physical activity; the role of nutrition in chronic disease development; nutrition throughout the life cycle and current nutrition-based controversies. Reviews the advantages and disadvantages to using dietary supplements. Addresses scientific research on recommended dosage and potential side effects. Addresses both the needs of competitive athletes and everyday needs and concerns. Upon completion of this course, students should be able to evaluate and make recommendations about diet plans, dietary supplements, as well as maintaining a healthy lifestyle. Focuses on the analysis of needs of various athletes to determine if specific supplements should be recommended to improve performance. Prerequisite: Year 2 Fall Courses
3 credits.

HAL 565: Research Design for Athletic Training

Presents research design and related methods commonly used to contribute to the evidence-based practice of athletic training. Provides the necessary tools for students to process and apply the skills needed to develop independent research studies. Includes literature searches, appraising scientific literature, formulating a research question or hypothesis, and selecting appropriate research designs and methods. Presents information in the context of protecting human subject and health information based on the policies and procedures of the Committee on Research Involving Human Subjects (CORIHS) and IACUC. Prerequisite: Year 1 Fall Courses
2 credits.

HAL 570: Research Methods for Athletic Training

This course introduces the student to research in athletic training. The student will learn about the research process, read, examine, and comprehend peer reviewed journal articles. The student will begin assembling a research topic related to athletic training through the development of a research question and the composition of a literature review and methodology based on their proposed topic. Prerequisite: Year 1 Spring Courses
2 credits.

HAL 571: Research Seminar I

This course is intended to review parametric and nonparametric statistics that will be implemented into students’ research design in an effort to draw statistical inferences and answer research questions. Once students receive IRB approval time will be allotted for students to recruit subjects and pilot test their research projects. If students complete their pilot testing, they will be afforded time to begin their final projects. Prerequisite: Year 1 Summer Courses
1 credit.

HAL 572: Research Seminar II

Culmination of the athletic training program’s research curriculum. Upon receiving IRB approval, students will recruit subjects and collect data to answer their research questions. The goal of this course is to complete the proposed research projects and develop a publishable manuscript and a poster that can be presented at a state, regional, or national conference. Prerequisite: Year 2 Fall Courses
1 credit.

HAL 575: General Medical Conditions

Provides a working knowledge of the pathophysiology and management of common diseases and other medical disorders or disabilities as they relate to athletes and the physically active. Prerequisite: Year 2 Summer Courses
4 credits.

HAL 581: Athletic Training Clinical I

This course provides the student with their first clinical experience. The student will be supervised by a preceptor at all times during their clinical experience. The student will practice patient care and professional skills and behaviors on a daily basis. Emphasis is placed on topics related to the student’s previous areas of classroom study (foundations of athletic training, principles of physical agents, evidence-based practice, lower extremity evaluation, diagnosis, and therapeutic intervention) and immediate incorporation of concurrent classroom topics (upper extremity evaluation, diagnosis, and therapeutic intervention, critical care). Prerequisite: Year 1 Summer Courses
7 credits.

HAL 582: Athletic Training Clinical II

This course offers assignments in clinical settings related to the student’s area of study (Principles of Physical Agents, Clinical Diagnosis and Treatment I & II, Critical Care). This course will give the student the opportunity to observe and integrate skills under the supervision of a preceptor. The student will practice comprehensive patient care and professional skills and behaviors on a daily basis in preparation for independent clinical practice upon graduation. Prerequisite: Year 1 Fall Courses
7 credits.

HAL 583: Athletic Training Clinical III

This course provides the student with their third clinical experience. This clinical experience will be full-time (a minimum of 35 hours per week). The student will be supervised by a preceptor at all times during their clinical experience. The student will practice comprehensive patient care and professional skills and behaviors on a daily basis in preparation for independent clinical practice upon graduation. Prerequisite: Year two Summer I courses
3-5 credits.

HAL 584: Athletic Training Clinical IV

This course provides the student with their fourth clinical experience. The student will be supervised by a preceptor at all times during their clinical experience. The student will practice comprehensive patient care and professional skills and behaviors on a daily basis in preparation for independent clinical practice upon graduation. Prerequisite: Year 2 Summer Courses
7 credits.

HAL 585: Athletic Training Clinical V

This course provides the student with their fifth clinical experience. This clinical experience will be full-time (a minimum of 35 hours per week). The student will be supervised by a preceptor at all times during their clinical experience. The student will practice comprehensive patient care and professional skills and behaviors on a daily basis in preparation for independent clinical practice upon graduation. Prerequisite: Year 2 Fall Courses
7 credits.

HAL 586: General Medical Clinical

This course provides the student with general medical clinical experience through rotations with health care providers in different settings. The student will be supervised by a preceptor at all times during their clinical experience. The student will practice comprehensive patient care and professional skills and behaviors on a daily basis in preparation for independent clinical practice upon graduation. Prerequisite: Year 2 Fall Courses
1 credit.

HAL 599: Clinical Continuation

Clinical continuation course for athletic training students only. S/F graded
May be repeated for credit.
**Occupational Therapy**

**HAO 500: Functional Neuroscience**

Presents an integrated approach to the general principles of organization and function of the autonomic, peripheral and central nervous systems. Presents these principles in a systems approach to neuroscience. The anatomy of a system will be followed with its physiology, pathophysiology relation to human function and clinical relevance to the occupational therapist. Clinical topics will include neurological testing, control of posture and balance, pain, muscle tone and spasticity, feedback versus feed-forward control, reflex versus voluntary control, control of reaching and locomotion, perception, and learning. Prerequisite: HAO 519, HAO 561

4 credits,

**HAO 504: Introduction to the Historical and Contemporary Practices of Occupational Therapy**

Introduces occupational therapy students to the values and philosophies that influenced the development of the profession, and those that continue to influence current practices. Explores conceptual foundations, ideas, evidence, and resources that allow learners to begin developing applied skills and clinical reasoning skills to support clients in achieving greater participation in the occupations they want and need. The goal of the course is to have learners develop beginning skills for conducting contemporary occupational therapy practices.

3 credits,

**HAO 505: Foundations in Occupational Therapy**

Provides a conceptual foundation for occupational therapy theory and practice. Instructs students on the concepts of occupation, activity, purposeful activity and participation. Through lecture and laboratory sessions, students will experience working with the concepts they are learning. Examines the philosophical base of the profession, and explores the meaning and diversity of the frames of reference in contemporary occupational therapy practice. Emphasizes the centrality of occupation in health and wellness, through balance in performance areas and contexts. Explores the impact of disability, disease, and injury on the person, their family and society. Students will learn how to break down and analyze activities for their performance components, as well as how to grade and adapt activities for therapeutic purposes. Group discussions on social and political systems will focus on how they influence the delivery of health care services.

2 credits,

**HAO 509: Occupational Therapy Theory and Practice in Pediatrics**

Presents occupational therapy theories, assessments, and treatment processes as they pertain to the pediatric population. Integrates several of the predominant models in current practice with material from previous and concurrent coursework. Covers abnormal development, acute and chronic medical conditions, their effect on the CNS, orthopedic and musculoskeletal systems. Reviews major causes of disability, the etiology and prognoses. Discusses the impact on the family and cultural implications. Students learn about selecting age and developmental stage appropriate evaluations, treatment techniques/procedures. Students enhance their activity analysis skills, assessment, treatment planning, documentation skills, and professional interaction through laboratory, class assignments, and fieldwork. Prerequisite: HAO 505; HAO 507; HAO 519; HAO 561

4 credits,
applications of principles discussed in lecture. In addition, the laboratory sessions will allow the student to become proficient in the areas of surface anatomy and palpation, manual muscle testing, and goniometry. The student will study normal and pathological movement, including its impact on function. Prerequisite: HAO 561

4 credits,

HAO 520: Substance Abuse and Occupational Therapy
This course addresses physiological, sociological, and psychological effects of substance abuse on the abuser and his/her environment. Presents drug classifications, along with effects and withdrawal symptoms. Discusses treatment models, philosophies, and methods. Students will learn how to design both individual and group interventions. Explores in detail the occupational therapists role in the evaluation and treatment of substance abuse across the life-span and across disabilities. Reviews the use of 12-step programs and alternative treatment models, as will prevention programs, such as smoking cessation. Requires Internet Explorer 10, 9, or 8; Firefox; Chrome; Windows 8, 7, Vista or XP; Mac OS X 10.6, 10.7 and 10.8; or Safari 5.1 and 6. Prerequisites: HAO 504; HAO 505, HAO 506, HAO 507; HAO 523.

2 credits,

HAO 522: Assessment and Treatment of Adult Rehabilitation
This is the second part of a two part course. Learning activities focus on the evaluation and treatment of adults with physical disabilities. Examines injury, illness, disease and the effect on occupational performance in the areas of work, self-care and leisure. Occupational therapy theories and practice are learned, including frames of reference, evaluation/assessments, treatment interventions, selection of age-appropriate occupation-based activities, and activity analysis are explored. Students will have the opportunity to further refine their documentation and clinical reasoning skills through written and verbal assignments and apply evidence based practices. Prerequisites: HAO 500; HAO 505, HAO 507, HAO 508; HAO 519; HAO 522; HAO 561

3 credits,

HAO 523: Assessment and Intervention of Psychosocial Issues
Explores the psychosocial aspects of disability as they affect the function of the individual, the family and the community. Lectures and presentations will be related to the recognition of psychosocial problems and how they can be better understood, minimized, or eliminated. Provision of mental health services across all levels of care will be delineated. Multicultural factors will be discussed as they relate to mental illness and the recovery process. The course exposes the occupational therapy student to the DSM-V and the pharmacology of major mental illnesses. Psychosocial theories guiding assessment and intervention will be thoroughly discussed. Interviewing skills are demonstrated and practiced in the lab sessions. The use of group theories, the structure and function of groups in treatment, the analysis of group treatment and group activities and the therapeutic use of self are the focus in laboratory and lectures. Students will be introduced to and given the opportunity to practice a variety of assessments utilized in psychosocial occupational therapy practice. This course is to provide the student with the knowledge, skills, and attitudes necessary to function as an occupational therapist in a psychosocial/mental health treatment setting. Prerequisite: HAO 504

4 credits,

HAO 524: Assessment & Interventions of the Upper Extremities
Presents fundamental upper extremity therapy topics and provides a foundation for clinical reasoning and treatment approaches. Include anatomy; common pathologies; orthotics; evaluation; and treatment. Introduces students to upper extremity orthotics including the design; biomechanical principles; function; use; care; and patient education. Enables the occupational therapy student to gain an understanding of various physical agents currently used in the rehabilitation practices. Prerequisites: HAO 500, HAO 507, HAO 508, HAO 519; HAO 522.

3 credits,

HAO 525: Vision, Perception, and Cognition
Focuses on principles and techniques for the rehabilitation of visuocognitive dysfunction. Presents the theoretical rationale and specific skills needed to evaluate and treat a wide range of visual, perceptual and cognitive performance components. Includes a systematic bottom up approach to the evaluation of the adult patient with visuocognitive dysfunction. Explores a variety of treatment approaches and specific treatment techniques that can improve functional performance and outcomes, drawing from both the neurosciences and Occupational Therapy frames of reference. Emphasizes clinical reasoning and the use of both remediation and compensatory strategies within the framework of Occupational Therapy practice. Prerequisites: HAO 500; HAO 505; HAO 507; HAO 508; HAO 561

2 credits,

HAO 526: Gerontology and Occupational Therapy
Focuses on the role of occupational therapy with the aged within geriatric rehabilitation settings (in-patient, out-patient and home care); long-term care programs; wellness and safety programs; hospice; community based programs (socialization, day treatment, adult day care programs), and alternative housing environments. Addresses the aging process and its physiological, sociological, and psychological effects, with attention to heterogeneity and older person's strengths and capabilities. Presents common impairments and disabilities and rehabilitation needs of older persons. Students will develop and demonstrate skills in evaluation, treatment planning and therapeutic adaptation, documentation, and discharge planning (including collaborative client and family education), and demonstrate knowledge of assistive devices, equipment, and technology/environmental modifications to support community living and to improve the quality of life of older persons. Addresses the importance of evidence-based practice, including occupational therapy, life-long learning and professional development, the benefits of collaborative OT/OTA partnerships and the relationships between policy, legislation and practice. Include aging and gender issues, successful aging, and community and home safety. Provides a conceptual framework for the study of gerontology as it relates to occupational therapy and develops the skills and knowledge to understand major issues in theory, research, and practice related to the older adult. Prerequisites: HAO 505, HAO 507, HAO 508, HAO 522

3 credits,

HAO 530: Community, Occupation and Health
Presents the importance of occupation as a precursor to health, and of occupational therapy as a health promoting profession. Examines the theories and applications of occupational science through a review of the professional literature and class discussion. This occupational perspective of health will be the foundation for each student's design of a community-based practice program. Reviews social theories, socio-cultural and socio-political trends that impact the individual's health status and the delivery of health care services. Offers experience in designing/administering needs assessments in the community, and in organizing outcome data.
HAO 500: Prosthetics & Orthotics
Provides the theoretical, psychomotor and practical skills of orthotics and upper extremity prosthetics that are necessary for current practice. Utilizes lecture, discussion and laboratories to teach the design, biomechanical principles, fit, function, use, care and patient education involved with upper extremity orthotics. Students are introduced to upper and lower extremity prosthetic devices. Prerequisites: HAO 500; HAO 507, HAO 508; HAO 519; HAO 522; HAO 524.

3 credits,

HAO 549: Introduction to Research for Occupational Therapy
Description: Provides a foundation for future professional and scholarly activities and stresses the importance of research for informed practice decisions. Presents basic research concepts and statistical applications for the research process. Presents methods to review and critique published, peer-reviewed research, identify research topics of interest, and initiate the literature review process. Provides tools needed to critique commonly used assessment tools in occupational therapy and to use and interpret standardized scores. Requires the CORIHS human subjects research training. Emphasizes professional writing skills for publications and professional presentations. Explores current research methodologies used in occupational therapy to facilitate beginning research skills. Prerequisite: Successful completion of all prior coursework.

3 credits,

HAO 551: Research Design and Methods for OT
Provides students beginning research and critical inquiry skills through learning current occupational therapy related research methods and by the design of research grant proposals. Students gain fundamental critical inquiry and writing skills necessary to identify appropriate funding sources and write grant proposals for research and program development. Students learn to design qualitative research projects and analyze qualitative data. Prerequisite: HAO 549

3 credits,

HAO 561: Functional Anatomy Review
Provides an anatomical review of all bodily systems in order for students to acquire a foundational knowledge of the functional structure of the human body. Provides foundational knowledge for all other courses in the Occupational Therapy Program. Students will apply knowledge learned to formulate hypotheses about occupational dysfunction associated with abnormalities within systems. Utilizes critiques of research to expand on knowledge from lecture and lab.

4 credits,

HAO 562: Principles of Instruction
Identifies issues facing health professions educators and application of knowledge of key education and behavior theories for occupational therapy practice. Explores commonly used instructional methods and applies these methods to a variety of teaching/learning situations found in occupational therapy education. Explores standardized tools to measure literacy, design of patient education materials for a specific population, and provision of health education information in a community setting. Prerequisite: Successful completion of all prior coursework.

3 credits,

HAO 570: Global Communities, Occupations and Health
Explores innovative, non-traditional and emerging areas of occupational therapy practice. Students meet and dialog with occupational therapy practitioners and/or other health care professionals who have developed private practices, are consultants, and are involved in emerging areas of practice. Presents timely articles concerning health care trends and non-traditional/emerging practice areas. Articulates global social issues and occupational needs for a variety of global populations. Builds upon student's prior knowledge and coursework and integrates AOTA's Standards of Practice, Core Values and Attitudes of OT, and AOTA's Code of Ethics, with attention to current and potential OT/OA partnerships in community and non-traditional settings. Prerequisite: Successful completion of all prior coursework.

1.5 credits,

HAO 573: Professional Behaviors I
Introduces professional behaviors, including basic communication and documentation skills, with a focus on expectations of fieldwork sites. Students will learn the concept of reflective practice, and how to use a reflective journal. Introduces the professional portfolio as a means to document clinical competence. Examines the nature of the supervisory process with strategies to maximize the use of clinical and administrative supervision. Explores cultural competency and the scope of diversity in health care. Emphasizes the importance of life-long learning through continuing education and other methods. Includes lectures, presentations, role-plays and other exercises to achieve learning objectives. Prerequisite: Year One Summer and Fall Courses

1 credit,

HAO 575: Professional Transitional Seminar
Discusses issues related to transition of student to entry-level practitioner role. Presents information on licensure, certification exam preparation, NBCOT certification, AOTA specialty examinations, models of supervision, mentoring, job search strategies, marketing skills, malpractice, continuing competency, professional organizations, networking and career goal planning. Prerequisite: Successful completion of all prior coursework.

2 credits,

HAO 576: Principles of Instruction
Identifies issues facing health professions educators and application of knowledge of key education and behavior theories for occupational therapy practice. Explores commonly used instructional methods and applies these methods to a variety of teaching/learning situations found in occupational therapy education. Explores standardized tools to measure literacy, design of patient education materials for a specific population, and provision of health education information in a community setting. Prerequisite: Successful completion of all prior coursework.

1.5 credits,
HAO 585: Disability Studies and Occupational Therapy
Introduces a social model of disability and explores the ethical and psychological issues faced by people with disabilities across their lifespan. Presents historical analysis, healthcare discourse, and cultural critique to understand the evolution of health practice, cultural beliefs and social structures influencing the treatments, services, and opportunities available to people with disabilities in the United States and internationally. Offers students a multi-layered understanding of the issues faced by people with disabilities and their families. Includes assigned readings, films, guest speakers, site visits, and one-on-one interactions with people with disabilities. Prerequisite: Successful completion of all prior coursework.

2 credits,

HAO 586: Fieldwork Level IA
The first of three introductory level clinical experiences. Offer the opportunity to identify symptomatology, observe treatment interventions and formulate treatment plans in a psychosocial practice setting. Promotes effective communication skills used with patients and professionals. Uses reflective journals to monitor development of professional behaviors and skills. Prerequisites: HAO 504, HAO 505, HAO 506, HAO 507; HAO 523

1 credit,

HAO 587: Fieldwork Level IB
This is the second of three introductory level clinical experiences. Provides students with the opportunity to identify symptomatology, observe treatment interventions, and formulate treatment plans in an adult physical disabilities setting. It is designed to promote effective communication skills used with patients and professionals. Reflective practice journals will be used to monitor professional behaviors and skills. Prerequisites: HAO 508, HAO 586.

1 credit,

HAO 588: Fieldwork Level IC
The third of three introductory level clinical experiences. Offers the opportunity to identify symptomatology, observe treatment interventions and formulate treatment plans in a pediatric practice setting. Promotes effective communication skills used with patients and professionals. Uses reflective journals to monitor development of professional behaviors and skills. Prerequisites: HAO 586, HAO 587

1 credit,

HAO 590: Independent Study in Occupational Therapy
Students develop and/or implement their research projects under the mentorship of the course instructor and a faculty advisor who has expertise in their chosen topic. Literature reviews are completed and the project is prepared in a format appropriate for professional publication or presentation.

2 credits, May be repeated 3 times FOR credit.

HAO 593: Case Studies
This clinical reasoning seminar focuses on the synthesis of all clinical and academic coursework in formulating a comprehensive plan of care. Emphasis is placed on students responding spontaneously to case presentations in class, much as they would be expected to do in the clinical setting. Prerequisite: Successful completion of all prior coursework.

2 credits,

HAO 595: Service Learning and Capstone Project
Incorporates in-depth theoretical and practical knowledge for maximum integration of service and classroom work. Includes discussion, journals, essays and other reflective writing methods. Explores reflection, action skill building, and examination of theory and practice of citizenship as applied though community involvement. Students provide 30 hours of service learning. A scholarly project will be the culminating activity for the program. Students will present outcomes of their service learning project in poster format. Prerequisite: HAO 597 and successful completion of all prior coursework.

4 credits,

HAO 596: Fieldwork Level IIA
Fieldwork IIA is an in-depth clinical experience in the delivery of occupational therapy services. According to AOTA guidelines, this fieldwork is designed to promote clinical reasoning and reflective practice; transmit values and beliefs that enable the application of ethics related to the profession; enable the student to communicate and model professionalism as a developmental process and career responsibility; and develop and expand a repertoire of occupational therapy assessments and interventions related to human occupation and performance. This first of two level II fieldwork experiences exposes the student to a variety of clinical conditions in a specific practice area for 12 weeks on a full time basis. Prerequisite: Successful completion of all prior coursework.

12 credits, S/F graded

HAO 597: Fieldwork IIB
This second clinical fieldwork experience provides the occupational therapy student with opportunities to apply the knowledge and skills learned thus far in the curriculum. Students will be assigned to a fieldwork site for 12 weeks on a full time basis in a particular area of practice. Prerequisite: HAO 596

12 credits, S/F graded

HAO 599: Fieldwork Continuation
This course is for occupational therapy students continuing with Fieldwork.

S/F graded

HAO 600: Foundations and Theory in Occupational Therapy
This course provides students with an understanding of the core principles of occupational therapy using the Occupational Therapy Practice Framework. The primary theories, models, and frames of reference that guide occupational therapy practice are introduced and applied using problem-based learning to facilitate future clinical courses.

3 credits,

HAO 601: Group Process, Client Communication, and Therapeutic Use of Self
This course teaches basic group and individual client-therapist interaction skills including methods of establishing rapport, giving feedback and employing therapeutic use of self. Students use frames of reference and practice models to design client-centered groups, write group protocols, analyze activities, implement specific group techniques and evaluate progress of self and group members. Prerequisites: All prior coursework must be completed

2 credits,

HAO 602: Occupational Therapy Task & Contextual Analysis
This course teaches students the process of activity analysis related to tasks and contexts. Students will analyze how body structures, body function, and client factors can support or hinder occupational performance. In addition, the students will develop the skills to analyze the various contextual features that can impact occupational performance. Prerequisites: All prior coursework must be completed

2 credits,
HAO 603: Occupations Across the Lifespan
The course provides students with knowledge of developmental theories and factors influencing the normal developmental process. Developmental norms and sequences are examined with emphasis on physical (sensory and motor), cognitive, and psychosocial tasks. Cultural and environmental influences on development are also discussed. The course covers prenatal, child, adolescent, and adult development. Prerequisites: All prior coursework must be completed 2 credits.

HAO 610: Functional Human Anatomy
This course provides an anatomical review of all body systems so that students can acquire a basic working knowledge of the functional structure of the human body. This knowledge is foundational for all other courses in the Occupational Therapy Program. Students will apply this knowledge of anatomy to formulate hypotheses about occupational dysfunction associated with abnormalities within the body's systems. Students will apply anatomical concepts discussed in class to occupational therapy case study examples and will critique and appraise research papers related to anatomical concepts discussed in lecture and lab. 4 credits.

HAO 611: Functional Neuroscience
This course describes the role of the nervous system in normal movement, cognition, and emotional functioning across the life span. It builds the foundation for professional theory and practice courses by providing neuroscience knowledge related to motor, sensory, and cognitive systems in order to understand movement and function, relate it to occupational performance deficits in the physical and cognitive domains, and to understand selected pathological conditions. The course presents an integrated approach to the general principles of organization and function of the autonomic, peripheral and central nervous systems. These principles will be presented in a systems approach to Neuroscience. The anatomy of a system will be followed with its physiology, pathophysiology, relation to human function, and clinical relevance to the occupational therapist. Clinical topics will include neurological testing, control of posture and balance, pain, muscle tone and spasticity, feedback versus feed-forward control, reflex versus voluntary control, control of reaching and locomotion, perception, and learning. Prerequisites: All prior coursework must be completed 3 credits.

HAO 612: Movement for Occupational Performance
This course is designed to establish a basis of biomechanical principles as well as detailed understanding of the osteokinematics and arthrokinematics of the various joints of the body. Normal and pathological movement is analyzed in relation to the impact on occupational performance. Prerequisites: All prior coursework must be completed 4 credits.

HAO 613: Conditions in Occupational Therapy
This first-year occupational therapy course will address clinical diagnoses, symptomatology, and prognosis of many major clinical conditions commonly encountered in current practice. In addition, there will be an emphasis on the impact of disease on individual physical, cognitive and emotional function and on families and society. Case studies will be utilized within this course to enable students to relate major theories and frames of reference to treatment approaches for common diagnoses and medical conditions. Prerequisites: All prior coursework must be completed 2 credits.

HAO 620: Assessment and Intervention in Mental Health
This course will explore the psychosocial aspects of disability as they affect the function of the individual, the family, and the community. Lectures and presentations will be related to the recognition of psychosocial problems and how they can be better understood, minimized, or eliminated. The provision of mental health services across all levels of care will be delineated. Multicultural factors will be discussed as they relate to mental illness and the recovery process. The course exposes the occupational therapy student to the Diagnostic and Statistical Manual of Mental Disorders (5th edition) (DSM-V) and the pharmacology of major mental illnesses. Psychosocial theories guiding assessment and intervention will be thoroughly discussed. Interviewing skills are demonstrated and practiced in the lab sessions. The use of group theories, the structure and function of groups in treatment, the analysis of group treatment and group activities, and the therapeutic use of self are the focus of laboratory and lectures. Students will be introduced to and given the opportunity to practice a variety of assessments utilized in psychosocial occupational therapy practice. This course is to provide the student with the knowledge, skills, and attitudes necessary to function as an occupational therapist in a psychosocial/mental health treatment setting. Prerequisites: All prior coursework must be completed 4 credits.

HAO 621: Assessment and Intervention in Physical Rehabilitation
The course focuses on occupational therapy and physical disabilities as they pertain to the adult population. Injury, illness, and disease and the effect on the functioning of the individual in self-care, work, and leisure are explored. It provides students with knowledge, laboratory experiences, and a framework to provide services to adults with physical dysfunction. This course addresses occupational therapy values, theory and practice, including frames of reference, evaluation, treatment planning, and a selection of age-appropriate occupations to support occupational performance, occupational analysis, and discharge planning. Students are provided with opportunities to demonstrate development of entry level documentation skills (evaluation, treatment planning, progress notes, discharge planning) and experiences to develop oral communication skills in preparation for fieldwork. The course is designed with laboratory sessions providing students with varied opportunities to develop an entry level knowledge base and broad-based clinical skills to successfully complete Fieldwork Level I and II experiences with a variety of clients in multiple types of traditional or community-based settings. Prerequisites: All prior coursework must be completed 4 credits.

HAO 622: Assessment & Intervention in Young Children
This course will provide an overview of occupational therapy in pediatrics, emphasizing the child from birth to five years of age and their families in the context of the environment, and culture. It will also present occupational therapy theories, assessments, and treatment processes as they pertain to current pediatric practice. This course will also analyze the predominant models of current practice and integrate effective treatment interventions. Abnormal development, acute and chronic medical conditions, and their resulting effects on the central nervous system, orthopedic and musculoskeletal systems will be addressed. Students will select occupation-based activities while adapting age and developmentally appropriate evaluations and treatment intervention strategies. The course material will utilize principles and methods of evaluation to include clinical reasoning.
critical thinking, and evidence-based practices. Prerequisites: All prior coursework must be completed
3 credits,

HAO 623: Assessment and Intervention in School-Based Practice
This course presents occupational therapy theories, assessments, and treatment processes as they pertain to current pediatric practice for children and adolescents in the school-based setting. The predominant models of current pediatric practice with evidence-based treatment interventions are introduced to the student. Emphasized in the course are abnormal development, acute and chronic medical conditions and their resulting effects on the central nervous system, orthopedic and musculoskeletal systems. The course also reviews major causes of disability, the etiology and prognosis and the impact on the family system and cultural implications. Students learn to select and adapt age and developmental stage appropriate evaluation and treatment intervention strategies. Finally, the students will learn how to analyze occupation-based activities for school aged individuals. Prerequisites: All prior coursework must be completed
3 credits,

HAO 624: Assessment and Intervention in Substance Abuse Treatment
This course addresses the physiological, sociological, and psychological effects of substance abuse on the abuser and his/her environment. Drug classifications will be presented, along with effects and withdrawal symptoms. Treatment models, philosophies, and methods are discussed. Students will learn how to design both individual and group interventions. The occupational therapist's role in the evaluation and treatment of substance abuse across the life-span and across disabilities will be explored and discussed in detail. The use of 12-step programs and alternative treatment models will be reviewed, as will prevention programs, such as smoking cessation. Prerequisites: All prior coursework must be completed
2 credits,

HAO 625: Physical Agent Modalities
This course presents physical agent modalities utilized as an adjunct to occupational therapy treatment. Modalities include therapeutic applications of thermotherapy, cryotherapy, ultrasound, paraffin, transcutaneous electrical nerve stimulation (TENS), and functional electrical stimulation (FES). The student will have the opportunity to practice the application of each modality on their peers. The physiological effects of physical agent modalities and their clinical uses and precautions/contraindications are addressed. Prerequisites: All prior coursework must be completed
1 credit,

HAO 626: Assessment and Intervention of the Older Adult
This course focuses on the role of occupational therapy with older adults in a variety of rehabilitative settings (inpatient, short term rehabilitation, home care, and outpatient), long-term care, community-based programs (health and wellness, fall prevention), alternative housing environments, and hospice. The aging process and its effects are explored, as are common impairments and rehabilitation needs of elders. Students also learn psychosocial and environmental influences on the heterogenous aging experience of elders, with attention to supporting autonomy and the older person's strengths in any context. Course lectures and activities address evidence-based practice, policy, and legislative issues that affect older adults, with topics including interpersonal relationships, assistive devices and equipment, community mobility, and aging in place. Applying this knowledge, students will develop and demonstrate entry-level skills in evaluation, treatment planning and delivery, documentation, and discharge planning (including collaborative client and family education) of older adults. Finally, this course is designed with laboratory sessions to provide students with varied opportunities to demonstrate knowledge to enhance the occupational participation, performance, and quality of life of older persons. Prerequisites: All prior coursework must be completed
3 credits,

HAO 627: Technological Applications in Occupational Therapy
The course centers on adapting the environment to improve the client's quality of life and enable societal reintegration. Areas covered include the Americans with Disabilities Act, mobility (power and manual), seating/positioning systems, adapted toys, augmentative communication systems, computer access, environmental control units, independent living aids, and vocational adaptations. The students analyze and integrate concepts of aging in place, functional capacity evaluations, and ergonomics. In addition, the students will be exposed to the different kinds of work settings that occupational therapists are employed in, become aware of federal regulations for work-related programs, and the certification requirements for this emerging practice area. The course material will include virtual environments, electronic medical records and telehealth technology as it relates to assistive technology, Functional Capacity Evaluations (FEC), aging in place, and work programs. Practical application of the principles discussed in lecture will be available during the course. Prerequisites: All prior coursework must be completed
3 credits,

HAO 628: Contemporary and Emerging Practices in Occupational Therapy
The course explores the delivery of occupational therapy services in emerging areas of practice. It provides students with knowledge of alternative models of service delivery and occupational therapy roles in care coordination, consulting, and case management. Students will learn about and discuss interprofessional role development and delineation. Further, they will build on their prior knowledge of the scope of occupational therapy to gain an understanding of ethical practice, malpractice and liability concerns, insurance reimbursement, and licensure statutes related to emerging practice areas. Students will participate in the process of identifying opportunities for occupational therapy's expansion via contemporary, nontraditional, and emerging practice areas, and will explore opportunities for their advanced doctoral capstone experiences. This course will prepare students to communicate and advocate for occupational therapy practice via various mechanisms and across audiences including potential funders, policy makers, the local/regional public, and interprofessional colleagues. Prerequisites: All prior coursework must be completed
3 credits,

HAO 629: Wellness and Health Promotion in Occupational Therapy
This course discusses the role of occupational therapy in wellness and health promotion. Students examine theories and evidence-based occupational therapy practice of health promotion and disease prevention for well and at-risk populations. Also explored is how occupation and lifestyle impact wellness, health, participation, and the prevention of disease and dysfunction in individuals, groups, and populations. Models of health promotion will be discussed and applied to demonstrate knowledge of how environmental contexts and epidemiological factors impact population health and welfare. This course prepares students to design and evaluate health promotion and wellness programs and to advocate for health promotion and wellness.
in their future practice settings and their own lives. Prerequisites: All prior coursework must be completed

3 credits,

HAO 630: Global to Community Practice in Occupational Therapy
This course presents the importance of occupation as a preceptor to health, and of occupational therapy as a health promoting profession. Theories and applications of occupational science will be examined through a review of the professional literature and class discussion. This course provides students with an occupational perspective of health that will be the foundation for a community-based practice program. The course will also review social theories, sociocultural and sociopolitical trends that impact the individual’s health status and the delivery of health care services. The student will demonstrate their depth of understanding through the design and presentation of an evidence-based, theoretically grounded, culturally, and temporally situated, community program. Prerequisites: All prior coursework must be completed

2 credits,

HAO 631: Professional Behaviors
In this course, the students work on documentation and communication skills for entry-level practice. Each student has the opportunity to discuss professional behavior expectations from their clinical fieldwork assignments. Reflective journaling is used to enhance professional development and to assist students in developing and documenting their clinical competence. The supervisory process is explored in detail, in the context of its use for personal and professional growth. The role of the occupational therapy assistant and other healthcare professionals, as both colleagues and collaborators, is discussed. The importance of life-long learning and advocacy is emphasized. Prerequisites: All prior coursework must be completed

2 credits,

HAO 650: Evidence Based Practice in Occupational Therapy
This course will provide students with knowledge on how to conduct literature searches, collect and analyze information to address a well-developed, clear, specific, answerable clinical question as the first step in the development of evidence-based practice. The students will use the literature to identify, assess, and discuss the value of implementing the treatment evidence. Prerequisites: All prior coursework must be completed

2 credits,

HAO 651: Introduction to Research Approaches and Designs
This course provides a foundation for future professional and scholarly activities. The importance of research for evidence-based practice is highlighted. Students learn research concepts and qualitative, quantitative, and mixed-methods research. Instruction in how to review and critique published, peer-reviewed research, identify research topics of interest, and initiate the literature review process is presented to the student. Tools needed to critique commonly used assessment tools in occupational therapy and to use and interpret standardized scores are included in the course. Students are required to have training in research ethics, such as “Responsible Conduct of Research” and “Protection of Human Subjects in Research”. Professional writing skills, which include writing grant proposals, research protocol development, and research presentations are also introduced in this course. Prerequisites: All prior coursework must be completed

2 credits,

HAO 652: Statistics in Occupational Therapy Research
Presents fundamentals of statistics and data analysis. Topics include descriptive statistics, statistical inference, tests for experimental comparisons, correlation, regression, and nonparametric tests. Students learn to use available computer programs for data management and statistical analysis. Discusses validity and reliability of various statistical techniques. Prerequisites: All prior coursework must be completed

2 credits,

HAO 654: Healthcare Policy & Advocacy in Occupational Therapy
This course provides students with an overview of trends in health care delivery systems and policymaking in the 21st century. A range of topics is included: health care systems; health policy and advocacy; outpatient and primary care; long-term care; medical technology; determinants of health and health disparities; and health services for special populations, among other current topics. The student will evaluate the human impact of health care policy and articulate the need for and process of advocacy for populations and individuals. In addition, the student will examine and articulate the distinct value of occupational therapy within the changing healthcare system and understand how occupational therapy functions within different funding mechanisms. Prerequisites: All prior coursework must be completed

2 credits,

HAO 661: Management and Business Fundamentals in Occupational Therapy
This course is designed to utilize lectures and activities to assist the learner in creating a business plan for an OT service. In the course of this process the student will learn skills involved in setting up a business, being a manager of people, budgets, and services, using evidence to guide management, and how to manage for change. This is a hybrid course that will consist of both online coursework, lectures and discussions along with on-site activities. Prerequisites: All prior coursework must be completed

2 credits,

HAO 662: Visionary Leadership in Emerging Practice
This course explores innovative, nontraditional and emerging areas of occupational therapy practice. Students meet and dialog with occupational therapy practitioners and/or other health care professionals who have developed private practices, are consultants, and are involved in emerging areas of practice. Students use timely articles concerning health care trends and non-traditional/emerging practice areas to create a potential IPE event for a community. Builds upon student’s prior knowledge and coursework and integrates American Occupational Therapy Association (AOTA)’s Standards of Practice, Core Values and Attitudes of OT, and AOTA's Code of Ethics, with attention to current and potential OT/OOTA partnerships in community and nontraditional settings. Prerequisites: All prior coursework must be completed

2 credits,

HAO 680: FW IA- Mental Health
This course is the first of three introductory level I clinical experiences and offers the student the opportunity to identify symptomatology, observe treatment interventions, and formulate treatment plans in a psychosocial practice setting. In addition, the student will have opportunities to observe effective communication skills used with patients and professionals. This course will also promote the development of professional behaviors and skills by the student. Prerequisites: All prior coursework must be completed

1 credit,

HAO 681: Fieldwork IB- Physical Disabilities

Stony Brook University Graduate Bulletin: www.stonybrook.edu/gradbulletin
The course is the second of three introductory level clinical experiences. It offers the student the opportunity to identify symptomatology, observe treatment interventions and formulate treatment plans in a physical disabilities practice setting. The student will be exposed to effective communication skills used with patients and professionals. The use of reflective journals to monitor development of professional behaviors and skills will enhance the students’ growth. Prerequisites: All prior coursework must be completed

HAO 682: Fieldwork IIA

This course is the third of three introductory level clinical experiences and offers the student the opportunity to identify symptomatology, observe treatment interventions, and formulate treatment plans in a pediatric practice setting. In addition, the student will have opportunities to observe effective communication skills used with patients and professionals. This course will also promote the development of professional behaviors and skills by the student. Prerequisites: All prior coursework must be completed

1 credit.

HAO 683: Fieldwork IIA

Fieldwork IIA is an in-depth clinical experience in the delivery of occupational therapy services. According to AOTA guidelines, this fieldwork is designed to promote clinical reasoning and reflective practice; transmit values and beliefs that enable the application of ethics related to the profession; enable the student to communicate and model professionalism as a developmental process and career responsibility; and develop and expand a repertoire of occupational therapy assessments and interventions related to human occupation and performance. This is the second of two-Level II fieldwork experiences that expose the student to a variety of clinical conditions in a specific practice area for 12 weeks on a full-time basis. Prerequisites: All prior coursework must be completed

12 credits.

HAO 690: Capstone Project Proposal

This course is the first of the capstone sequence and will prepare students for their Capstone Residency and Project. Students will explore their interest area(s) for their residency and identify relevant projects. Students will create a plan for development of their capstone with clear learning objectives that demonstrate a focus on in-depth knowledge. Prerequisites: All prior coursework must be completed

2 credits.

HAO 691: Capstone Residency

The full-time, 14-week doctoral capstone experience is the second course in the doctoral capstone sequence. The capstone residency enables students to achieve specialized skills in one or more of the following areas: clinical practice skills, research skills, administration, leadership, program and/or policy development, advocacy, education, theory development, or other innovative practice. Under the supervision of an expert mentor, students will execute their doctoral capstone plan established in HAO 690 by meeting the individualized objectives and completing a relevant culminating capstone project. Prerequisites: All prior coursework must be completed

14 credits.

HAO 692: Capstone Project Completion and Dissemination

This course will conclude the occupational therapy doctoral capstone sequence. Students will complete, present, and disseminate their capstone projects. Prerequisites: All prior coursework must be completed

2 credits.

HAP

Physician Assistant

HAP 501: Community Health and Service Learning for Physician Assistant

Provides opportunities for PA students to learn and reinforce medical knowledge and skills through service to local and international communities. Learning methods will enhance the acquisition of clinical skills, cultural competencies and expand knowledge of community resources for underserved populations. Open to entry-level PA students only.

2 credits.

HAP 504: Professional Practice Issues

Provides information critical to understanding the development and organization of the physician assistant profession in the United States. Explores the dynamics of PA practice, including such issues as responsibilities to patients and the public, professional regulation and involvement, team care, cultural diversity, and developing trends in PA practice. Encourages the exploration, critiques, and evaluation of professional practice issues related to the quality, delivery and cost-effectiveness of our nation's health care system. Open to entry-level PA students only.

2 credits.

HAP 509: Integrative Systems Physiology

Introduces students to human integrative systems physiology. Includes exposure to physiological control systems, emphasizes in detail each organ system and how homeostasis is maintained. Includes membrane, muscle, central and peripheral nervous system, cardiovascular, respiratory, renal, gastrointestinal, and endocrine physiology. Presents material and incorporates select examples of pathophysiology to emphasize relevance of material. Students will solidify an understanding of the structures and functions across all systems in the human body under normal conditions and select pathophysiology. Knowledge gained of normal function will be applied towards making predictions about physiologic function in response to disease states. Students are expected to gain a cumulative understanding of physiologic function and are challenged to apply this knowledge towards problem solving and interpreting physiologic scenarios. Open to entry-level PA students only.

4 credits.

HAP 510: Clinical Laboratory Medicine

Presents fundamental principles of laboratory medicines. Strengthens the student's ability to select, perform and interpret the results of basic clinical laboratory procedures to aid in formulating a preliminary diagnosis and management plan. The course is offered after students have acquired a foundation in human physiology and anatomy. Open to entry-level PA students only.
May be repeated 2 times FOR credit.

HAP 521: Clinical Medicine I
Focuses on mastery of the knowledge, skills, and attitudes necessary to construct a comprehensive patient database and management plan. Students are introduced to, and become proficient in, medical interviewing and performing a physical examination. Emphasizes the process of synthesizing data to formulate a diagnostic plan through learning activities such as lectures, small group process, problem based learning, case studies, and clinical skills laboratories. Teaches data gathering and recording in the problem oriented medical record format. The diagnostic process is taught in an organ systems (or medical subspecialty) approach. Students learn to recognize and manage physical and mental health problems. Students are encouraged to think critically as an integral part of developing a logical, sequential and humanistic approach to their patient responsibilities and mastering medical information. The ultimate goal of these clinical medicine courses is to insure that students are optimally prepared to participate in the delivery of high quality medical care in both an in-patient and out-patient setting. This course has an associated fee. Please see www.stonybrook.edu/coursefees for more information. Open to entry-level PA students only.

HAP 522: Clinical Medicine II
Focuses on mastery of the knowledge, skills, and attitudes necessary to construct a comprehensive patient database and management plan. Students are introduced to, and become proficient in, medical interviewing and performing a physical examination. Emphasizes the process of synthesizing data to formulate a diagnostic plan through learning activities such as lectures, small group process, problem based learning, case studies, and clinical skills laboratories. Data gathering and recording are taught in the problem oriented medical record format. The diagnostic process is taught in an organ systems (or medical subspecialty) approach. Students learn to recognize and manage physical and mental health problems. Students are encouraged to think critically as an integral part of developing a logical, sequential and humanistic approach to their patient responsibilities and mastering medical information. The ultimate goal of these clinical medicine courses is to insure that students are optimally prepared to participate in the delivery of high quality medical care in both an in-patient and out-patient setting. Prerequisite: HAP 521 (minimum grade of B-). Open to entry-level PA students only.

HAP 523: Clinical Medicine III
Focuses on mastery of the knowledge, skills, and attitudes necessary to construct a comprehensive patient database and management plan. Students are introduced to, and become proficient in, medical interviewing and performing a physical examination. Emphasizes the process of synthesizing data to formulate a diagnostic plan through learning activities such as lectures, small group process, problem based learning, case studies, and clinical skills laboratories. Data gathering and recording are taught in the problem oriented medical record format. The diagnostic process is taught in an organ systems (or medical subspecialty) approach. Students learn to recognize and manage physical and mental health problems. Students are encouraged to think critically as an integral part of developing a logical, sequential and humanistic approach to their patient responsibilities and mastering medical information. The ultimate goal of these clinical medicine courses is to insure that students are optimally prepared to participate in the delivery of high quality medical care in both an in-patient and out-patient setting. Prerequisite: HAP 522 (minimum grade of B-). Open to entry-level PA students only.

HAP 524: Clinical Medicine IV
Focuses on mastery of the knowledge, skills, and attitude necessary to construct a comprehensive patient database and management plan. Students become proficient in utilizing the history and physical information as they begin to synthesize data to formulate a diagnostic plan. This is emphasized through learning activities such as lectures, small group process, case studies, and clinical skills laboratories. The diagnostic process is taught in an organ systems approach. Students learn to both recognize and manage physical and mental health problems. Students are encouraged to think critically as an integral part of developing a logical, sequential and humanistic approach to their patient responsibilities and mastering medical information. This course has an associated fee. Please see www.stonybrook.edu/coursefees for more information. Prerequisite: HAP 523 (minimum grade of B-). Open to entry-level PA students only.
HAP 528: Genitourinary, Sexual and Reproductive Health
A comprehensive introduction to obstetrics and gynecology (OB/GYN), female and male genitourinary system (GU) and human sexuality. Students will learn about structures, function, evaluation and treatments of the various diseases and conditions. This course has an associated fee. Please see www.stonybrook.edu/coursefees for more information. Open to entry level PA students only.
4 credits,

HAP 532: Diagnostic Imaging
Provides an overview of common diagnostic imaging modalities and their indications, limitations, benefits and potential risks. Students learn how to utilize plain radiographs and other imaging studies in the diagnosis of disease with an emphasis on recognition of normal findings and their comparison to the abnormalities found in disease processes. Open to entry-level PA students only.
2 credits,

HAP 534: Introduction to Clinical Psychiatry
Presents key principles of psychiatric evaluation and interviewing to include the mental status exam. Focuses on psychiatric problems seen in primary care, introduces the differential diagnosis and treatment of major psychiatric disorders such as anxiety, personality and mood disorders, psychosis, substance abuse, and somatoform disorders. Fosters an awareness of social patterns that exert an impact on mental functioning. Open to entry-level PA students only.
3 credits,

HAP 545: Ethics and Health Care for Physician Assistants
Provides an overview of ethics in health care in a rapidly changing society. Teaches students to approach ethical dilemmas using theoretical frameworks and decision making processes. Explores ethical issues surrounding health care reform and public health policy and includes distribution of resources and rationing of services. Introduces students to the ethical perspectives of euthanasia, reproduction, transplants, genetics, research on human subjects, pediatrics, cloning, stem cells and mental health through case studies. Reviews classic cases in health care ethics and their shaping of health policy. Discusses patient education and the Physician Assistant professional codes of ethics and standards. Open to entry-level PA students only.
3 credits,

HAP 549: Clinical Skills for the Physician Assistant Student
The clinical skills course provides the physician assistant student with an overview of common clinical procedural skills and their indications, limitations, benefits and potential risks. Students are taught how to perform a number of commonly performed clinical procedures. This course has an associated fee. Please see www.stonybrook.edu/coursefees for more information. Open to entry-level PA students only.
1 credit, S/F graded

HAP 551: Research Design and Evidence-Based Medicine
Provides students with basic knowledge and skills needed to formulate research questions and hypotheses, develop research protocols, critically evaluate and analyze scientific and medical journals, and to conduct computerized searches and literature reviews. Describes principals of Evidence-Based Medicine and emphasizes various types of clinical questions and tools available to answer them. By the end of this course, the student will choose a proposed topic for their capstone project. Open to entry-level PA students only.
2 credits,

HAP 561: Master's Project I
Students will work with a faculty mentor to develop a clinical question and perform an initial literature search on a topic of interest. Topics should be well-focused and may include psychological, economic or ethical issues in health care as well as diagnostic or treatment-related questions. Following review by a faculty mentor, the student will submit summaries of selected articles as well as a outline. Open to entry-level PA students only. Prerequisite: HAP 551
1 credit,

HAP 562: Masters Project II
Students will work with their faculty mentor to refine a clinical question and revise the presentation outline and article summaries submitted at the end of HAP 561. Emphasis will be placed on thoroughness of the literature search and clarity of the presentation. By completion of this course, students should have the presentation in its final, and have developed a draft of a final paper. Open to entry-level PA students only. Prerequisite: 561
1 credit,

HAP 563: Masters Project III
Students will revise the presentation submitted at the end of HAP 562 with input from their faculty mentor, who will guide them in developing a concise, professional-appearing product, suitable for presentation at a professional conference. Students will present this to the faculty and other members of the class, and will be evaluated on the content, visual, and oral components of their work. Students will also complete and submit their final paper. Open to entry-level PA students only. Prerequisite: HAP 562
1 credit,

HAP 570: Internal Medicine Clerkship
Provides practical clinical experience in caring for adult hospitalized patients on a medical service. Strengthens the student's skills in developing a comprehensive database with regard to a wide variety of common inpatient medical problems, stressing mastery of cognitive and affective information that enables the student to recognize normal and assess deviation from normal, and effectively consult and refer. Exposure to out-patient care is often included. Students learn to address personal and social issues that influence the care of the medical patient. This course has an associated fee. Please see www.stonybrook.edu/coursefees for more information. Prerequisite: Successful completion of preclinical year courses.
5 credits,

HAP 571: Obstetrics and Gynecology Clerkship
Provides students with practical clinical experience in the differential diagnosis, evaluation, management, and consultation and referral for normal and abnormal conditions in obstetrics and gynecology. Students will gain skills in obtaining patient histories, physical diagnosis and medical decision making through exposure to a broad base of patients with a wide variety of personal and social issues that influence patient care. Prerequisite: Successful completion of preclinical year courses.
5 credits,

HAP 572: General Surgery Clerkship
Provides students with practical clinical experience in the evaluation and management of surgical patients. Through exposure to a broad base of surgical patients, students will master the knowledge, attitudes and skills necessary to obtain focused patient histories and physical exams, construct a differential diagnosis, make sound medical decisions, and effectively consult and refer. Students will learn to address a variety of personal and social issues that influence the care of the surgical patient. This course has an associated fee. Please see www.stonybrook.edu/coursefees for more information. Prerequisite:
Successful completion of preclinical year courses.  
5 credits,  

**HAP 574: Emergency Medicine Clerkship**
Provides students with practical clinical experience in the medical care of acutely ill or injured patients. Students will enhance skills in obtaining focused patient histories, performing focused physical examinations, mastering emergency medical management and decision making, and effective consultation and referral. Emphasis is placed on student recognition of life threatening situations and the response to such situations. Students will learn to address a wide variety of personal and social issues that influence the care of the emergency medical patient. Prerequisite: Successful completion of preclinical year courses.  
5 credits,  

**HAP 575: Psychiatry Clerkship**
Provides students with practical experience in the recognition, evaluation and management of patients with mental illness. Through clinical interaction with mental health patients and workers, students will develop an understanding of the biological and psychosocial factors that influence a variety of psychiatric conditions, and effectively consult with other professionals and refer patients to the support services that are required to optimize the care of the psychiatric patient. Students will learn to address a wide variety of personal and social issues that influence the care of this patient population. Prerequisite: Successful completion of preclinical year courses.  
4 credits,  

**HAP 576: Medicine Preceptorship**
Provides students with practical clinical experience working with the ambulatory medical patient. This preceptorship augments and develops directed data collection skills emphasizing a wide range of primary care medical problems and their management. Cognitive and affective skills that enable the student to recognize normal and assess abnormal findings and effectively consult and refer are a key aspect of learning during this experience. Students will learn to address a wide variety of personal and social issues that influence the care of the medical patient. This course has an associated fee. Please see www.stonybrook.edu/coursefees for more information. Prerequisite: Successful completion of preclinical year courses.  
5 credits,  

**HAP 577: Pediatric Preceptorship**
Provides students with practical clinical experience working with ambulatory pediatric patients. Through exposure to a wide variety of primary care pediatric problems, students will develop directed data collection and patient management skills and learn how to effectively consult and refer. The preceptorship stresses those cognitive and affective skills that enable the student to recognize normal findings and assess abnormal findings. Students will learn to address a wide variety of personal and social issues that influence the care of the pediatric patient.  
5 credits,  

**HAP 579: Geriatrics Clerkship**
Provides students with practical clinical experience in working with elderly patients. Augments and strengthens students' skills in developing a thorough database and enhances student understanding of when to request a consultation or make a referral. Students work with a wide variety of common geriatric problems and learn how to appropriately modify their management approach to the indications, limitations, and methodology of diagnostic procedures and therapeutic regimens in the elderly. Students will also learn to address a wide variety of personal and social issues that influence the care of the geriatric patient. Prerequisite: Successful completion of preclinical year courses.  
5 credits,  

**HAP 580: Orthopedic Clerkship**
Provides students with practical experience in the care of patients with musculoskeletal disorders and acute injuries in the primary care setting. Students will develop the knowledge, attitudes and skills necessary to obtain directed patient histories, perform focused physical exams, make sound clinical decisions, and effectively consult and refer through exposure to patients with a wide variety of orthopedic problems. Students will learn to address a wide variety of personal and social issues that influence the care of the orthopedic patient. Prerequisite: Successful completion of preclinical year courses.  
4 credits,  

**HAP 581: Clinical Elective**
Provides students with the opportunity to explore an area of medical or surgical practice beyond basic required rotations. Students are encouraged to choose an area of emerging importance in health care and PA practice and/or a potential employment setting. This elective clerkship further augments and develops patient management skills in the chosen medical or surgical discipline and must be selected in consultation with the student's program faculty advisor. Students will learn to address a wide variety of personal and social issues that influence the care of many patients. Prerequisite: Successful completion of preclinical year courses.  
4 credits,  

**HAP 599: Clinical Continuation**
This course is for physician assistant students continuing with clinical.  
S/F graded  
May be repeated for credit.  

**HAS**

**Allied Health**

**HAS 500: SHTM Advanced Standing**
Place holder credits for Health Technology and Management students.  
0-9 credits. S/F graded  
May be repeated 3 times FOR credit.  

**HAS 561: Spanish for Healthcare Professionals**
This course combines an overview of intermediate-level Spanish grammar with vocabulary and cultural elements relevant to the healthcare field. Intended for health professional students. Prerequisite: At least 2 semesters of college level Spanish or 2 years of high school Spanish. Please contact the instructor if you are not sure about your proficiency level.  
1 credit,  

**HAS 590: Independent Study**
Independent study proposals in health sciences. Must have the approval of the Research and Directed Study Committee of the School of Health Professions prior to registration.  
0-6 credits,  

**HAS 591: Independent Readings**
Supplementary specialized readings for graduate students under faculty supervision. Topics include but are not limited to: community and public health, mental health, health policy, health care management, health care ethics, gerontology, patient education and health economics and policy. Approval must be obtained from the Research and Directed Study Committee of the School of Health Technology and Management prior to registration.  
1-3 credits,  

**HAS 592: Special Topics**
Presented a comprehensive look at specific aspects of health policy from all relevant perspectives. Synergizes scientific, legislative and ethical points of view and how their relationship to policy formulation and implementation. Students will expand skills to effectively articulate details of the policy and develop an educated position on it. Dynamic discussion, essay writing and debate will be utilized to gauge information comprehension and opinion development.

3 credits, 
May be repeated 2 times FOR credit.

HAS 599: Maintenance of Matriculation
This course is for students who are maintaining matriculation while engaging in consultation with faculty regarding completion of courses and/or master's project. Students will be graded S/F.
0-3 credits, S/F graded
May be repeated for credit.

HAX
Health and Rehabilitation Sciences

HAX 600: Doctoral Seminar
Provides a venue for faculty and doctoral students to discuss all aspects of their research. Researchers will present different branches of translational science and discuss linkage between research agendas. Provides opportunity for data to be viewed and analyzed by investigators with different perspectives and tools for analysis. Offered in the
Fall, S/U grading
May be repeated for credit.

HAX 602: Frameworks, Models and Classification Systems in Health and Rehabilitation Sciences
Examines the dynamic interaction between health, disability, and community and contextual factors as identified using different frameworks and models. These frameworks and models will be expounded to recognize the influence of each solely and collectively in terms of health and rehabilitation research, disability studies, and behavioral and community health research. Explores parallels and divergences in approaches with particular attention to analyzing how students in varied concentrations can work together to engage in meaningful translational research within the domains of historical and present-day society and research paradigms.
3 credits,
May be repeated for credit.

HAX 605: Research Ethics
Provides a broad overview of research ethics and regulation. Conveys the moral base of scientific ethics, the historical evolution of social science and biomedical research ethics, and the development, implementation and limitations of U.S. human subjects regulations. Includes ethics and morality in science; science in society; scientific integrity; misconduct; whistle blowing; conflicts of interest; collegiality; publication and authorship; peer review; history and development of human experimentation ethics and regulations (HHS, FDA); Institutional Review Boards; informed consent, waivers, vulnerable populations; privacy and confidentiality of records; epidemiology; and research using animal subjects.
3 credits,

HAX 620: Rehabilitation and Disability
Introduces the Science of Rehabilitation and the Science of Disability. Presents models of rehabilitation and disability research and discusses controversies and commonalities between these areas. Forms the groundwork of future coursework in rehabilitation and movement sciences.
3 credits,

HAX 626: Outcome Measurement in Rehabilitation Research
Introduces outcome measures relating to impairments, functional limitations and disability, general health status, and patient/client satisfaction. These outcome measures are used to guide research outcomes. Explores measurement properties and discusses strategies to appropriately assess and select various outcome measurement scales. Critical appraisal of the literature will provide the basis for making research methodological decisions regarding selection of the most effective outcome measures.
3 credits,
May be repeated for credit.

HAX 629: Evidence Based Pediatric Rehabilitation Research
Provides students an opportunity to develop an overview of issues related to the health of America's children and adolescents. Emphasizes chronic disease and disability, nutrition, fitness, educational accommodations, and trends in long term health services and health policy. Explores the growing need for evidence based practice and outcomes assessment necessary for the development of strategies for optimal function of children with disease/disability and their families. Students will review and analyze evidence for interventions for a specific pathology/disability.
3 credits,
May be repeated for credit.

HAX 630: Exercise Physiology and Physical Activity
Provides key elements of exercise physiology and instructs students in measurement techniques for the assessment of exercise capacity and physical activity. Reviews normal physiology of the cardiopulmonary system and presents normal immediate response to exercise, and long-term effects of exercise in the healthy individual. Explores foodstuffs for energy production, metabolic pathways for production of ATP, and energy systems used in aerobic and anaerobic activities. Principles of physical activity assessment and body composition and examines qualitative and quantitative measurement techniques across the lifespan and in disability. Assimilates, via lab manual, literature reviews of articles addressing measurement.
3 credits,
May be repeated for credit.

HAX 631: Electro/Neurophysiology: Topics for Rehabilitation Research
Introduces basic methodology of clinical electrophysiologic measures of EEG, EMG, nerve conduction velocity studies (NCV), H-reflex and evoked potentials. Interpretation of these measures provides access to the physiological basis of disability in peripheral or central nerve damage and potentials for recovery. Examines the interventions using peripheral and central electrical stimulation modalities on muscle, bone, cardiovascular and autonomic systems. Includes lab activities of selected modalities such as E-stim, FES, TMS, EEG, EMG, NCV, and H-reflex.
3 credits,
May be repeated for credit.

HAX 632: Teaching and Learning
This course will introduce students to adult learning principles and strategies for effective teaching of cognitive psychomotor and affective skills and behaviors in academia. Individual teaching/learning philosophical orientations, characteristics of the adult learner, learning styles, self-directed learning, and reflective practice will be explored.
3 credits,
May be repeated for credit.

HAX 634: Motor Learning and Motor Control
This course will introduce the various theories underlying human motor control. Students will actively synthesize and analyze current theory and research related to motor control and skill acquisition through examination of
relevant literature. This course places emphasis on determining the implications of this work for future research, educational, and clinical practice. Includes early and contemporary theory, skill acquisition facilitation, practice, feedback, transfer of training, modeling, part vs whole training, imagery, implicit learning, explicit learning, and memory systems.

3 credits.
May be repeated for credit.

HAX 635: Biomechanics and Movement I
Introduces students to principles and interrelationships of biomechanics and movement. Includes physical biomechanics of the extremities as a foundation from which to apply biomechanical principles. Involves learning to use mathematical approaches to solving static problems and lay the groundwork for solving dynamic biomechanical problems. Reinforces biomechanical theoretical concepts and mathematical models and lab experiments that involve the manipulation of 3D kinematic, kinetic and EMG data.

3 credits.
May be repeated for credit.

HAX 636: Biomechanics of the Musculoskeletal System and Movement II
Provides advanced concepts of kinetics in the field of biomechanics. Explores biomechanical concepts during lecture and reinforces those applications with associated lab experiments. Provides viscoelastic characteristics of biological tissues as a foundation applied to human motion. Includes mathematical models of the musculoskeletal system and analysis of the dynamics of human motion. Collection and analysis of gait and other movement kinematics, kinetics and muscle activation by electromyography (EMG) are components of lab activities.

3 credits.
May be repeated for credit.

HAX 637: Orthopedic and Anatomical Principles I
Provides advanced concepts of orthopedics and anatomy. Focuses on best evidence of examination, evaluation, diagnosis, prognosis, and procedures used for a variety of orthopedic conditions of the spine and pelvis. Requires active engagement in problem solving by identifying research problems, searching for evidence, and evaluating and synthesizing the evidence to answer research questions. Includes examination of select advanced procedures and principles to enhance research investigations.

3 credits.
May be repeated for credit.

HAX 638: Orthopedic and Anatomical Principles II
Continues and expands on advanced concepts of orthopedic interventional research. Focuses on best evidence of examination, evaluation, diagnosis, prognosis, and intervention of orthopedic conditions of the extremities. Requires active engagement in problem solving by identifying research problems, searching for evidence, and evaluating and synthesizing the evidence to answer research questions. Student directed pilot study will incorporate knowledge of select advanced techniques and technologies.

3 credits.
May be repeated for credit.

HAX 639: Technology and Medical Imaging in Rehabilitation
Examines a range of medical imaging techniques available for use and interpretation in rehabilitation research. Includes radiographs, fluoroscopy, MRI, fMRI, CT, qCT, MEG, TMS and diagnostic US. Synthesizes the technologies and their limitations, the methods of capture and interpretation. Reviews evidence supporting or refuting the sensitivity of these techniques in determining outcomes in rehabilitation.

3 credits.
May be repeated for credit.

HAX 640: Community Health and Community Based Participatory Research
Provides an overview of critical issues in conducting research in community settings including models of community-based services. Covers the general principles of community-based participatory research, and practical ethical issues in collaborating with communities, quantitative and qualitative techniques used in community-based participatory research, evaluations, and interventions. Prerequisite: 24 credits of HAXPH core courses or Permission of Instructor.

3 credits.
May be repeated for credit.

HAX 641: Community Mental Health
Explores the policies and programs that address mental health needs of individuals with a community health focus. Students will apply models of behavior and health to explore topics of mental health including stigma, marginalization, self-determination. Discusses challenges to service provision. Focuses on the ethics of research with this population as a central theme.

3 credits.
May be repeated for credit.

HAX 642: Participation and Health in Pediatric and Educational Settings
Explores policies and programs that inform pediatric services and community based research. Focuses on pediatric programs that influence health and community participation. Includes programs that support health, wellness, and community participation as well as those influenced by the Individuals with Disabilities Education Improvement Act (IDEA) that supports children with disabilities from Birth to 21 years. Prerequisites: 24 credits of HAX core courses or permission of Instructor.

3 credits.

HAX 643: Healthcare Systems and Policy Analysis
Provides students with an overview of the US healthcare system and major health policy challenges we face. Explores the history and state of the US healthcare system, and circumstances that have given rise to current problems such as employer-based health insurance, challenges in access to and quality of care, and the rising costs associated with the US healthcare model. Discusses ways to improve upon the system, importantly including the Affordable Care Act, and how this legislation was enacted with close attention paid to the policymaking process, roles of political actors, and the importance of policy analysis.

3 credits.
May be repeated for credit.

HAX 644: Ethics, Health Disparities and Social Justice
Examines aspects of inequality and health status as an injustice within the context of ethical theories (utilitarian, libertarian, deontological, egalitarian). Determines the influence on case studies of health disparities and inequalities. Discusses cases such as global and U.S. racial, class and gender disparities and in developing countries. Presents ethical issues relative to different methods of measuring health inequalities and related policies.

3 credits.
May be repeated for credit.

HAX 645: Organizational Theory, Management and Leadership
Examines theoretical and conceptual framework for understanding leadership and management styles of health and human services organizations and how they operate in a broader community. Identifies and applies strategic models to analyze organizational
problems, organizational behaviors and processes, formulate strategic solutions, and make sound decisions. This knowledge is critical for the behavioral and community health field to understand how individuals influence and are influenced by organizations.

3 credits,  
May be repeated for credit.

HAX 646: Social Behavior and Community Health Change  
Examines the nature of the behavior that takes place within social systems and how to effectuate change in these systems. Analysis of behavior and possibilities for change will be placed in the context of health and public health questions and will draw upon theories of organizational behavior, leadership, and mechanisms for action.

3 credits,  
May be repeated for credit.

HAX 647: Policies and Ethics in Behavioral and Community Health  
Explores health care policies of the US health care system and the influence on public health and programs in behavior and community health. Includes access and utilization of health care, barriers to care, prevention programs, and health disparities and ethics. Addresses the perspectives of the consumer, provider and the institution.

3 credits,

HAX 653: Research Methods: Design and Statistics  
This course presents process and skills needed to develop independent research studies, including but not limited to, formulating a research question or hypothesis, conducting literature searches, critically appraising scientific literature, and selecting appropriate research designs and methods. This information will be presented in the context of protecting human subjects and health information based on the policies and procedures of the Committee on Research Involving Human Subjects (CORIHS) and IACUC.

3 credits,  
May be repeated for credit.

HAX 656: Qualitative Research  
Students will learn the basic principles and techniques of effective analysis and interpretation of the merits of qualitative data. Examines how qualitative research captures complex phenomena that span the international classification of function (ICF) and impact on quality of life, illness/injury experience and recovery. Students will learn the strengths and limitations of qualitative analysis and how it complements quantitative analysis. Emphasizes several methods to represent data, such as the mixed method approach, and students will apply a range of analysis techniques through research exercises.

3 credits,  
May be repeated 1 times FOR credit.

HAX 663: Disability, Occupation and Community  
Inspired by disability justice social movements in the US and abroad, this course presents politically engaged critical approaches to disability that intersect community organizations, the arts and academic fields including occupational therapy, disability studies and anthropology. Broader than a medical category, disability identity recognizes the political and economic dimensions of disability inequity as it related to other forms of inequality and disadvantage. Themes include all permutations of the concept of disability justice/decolonization; participation and training for collaborations; marginalization and minoritization; technology; struggle, creativity, and change.

3 credits,

HAX 664: Conceptual Foundations of Disability Studies 1890s-1990s  
Present conceptual foundations of disability studies beginning with the 19th and early 20th century theories and scholarship. Theorists from the 1960s and 1970s who influenced the theoretical development of the new field of disability studies will be discussed. The course will explore foundational disability studies scholarship of the 1980s and 1990s as the field established itself first in the social sciences and then the humanities.

3 credits,

HAX 665: Disability, Participation and Justice  
Explores concepts of “Participation” and “Justice” as they relate to disability experience. Introduces research strategies, participatory methods and methodologies for disability studies research in the applied social and health sciences. Discusses ethical issues in disability research and what it means to disabled people in daily life. Examines social analysis, healthcare discourse, and research on the evolution of healthcare practices, cultural beliefs, and social structures influencing the treatments, services, and opportunities available to disabled people in the United States and internationally.

3 credits,  
May be repeated for credit.

HAX 667: Disability Studies Language, Narrative and Rhetoric  
Focuses on how language and rhetoric frame how disability is perceived, experienced, and treated. Included critical and rhetorical analysis of professional discourses as well as personal disability narratives and memoirs. The society for Disability Studies, an interdisciplinary organization, says in its mission statement, disability is a key aspect of human experience. So is language. This course explores the interdisciplinary nature of disability studies and the roles language and rhetoric play in representations of disability. Some questions to be explored include: In what ways do clinical or professional discourses and personal narratives reveal experience of power and powerlessness? How is the bodily experience of disability described in professional contexts as compared to personal narratives? How does description and perception influence the practice of professionals and quality of life for people with disabilities? What assumptions about disability are revealed through rhetorical analysis? These questions will frame our attention to representations of disability in a variety of texts: academic, professional, literary, clinical, personal, and visual. Not to be taken for credit with ESL 592

3 credits,

HAX 668: Emerging Topics in Disability Studies  
Focuses on the intersections of disability with other emerging area studies such as gender, class, sexuality, race and global studies. Encompass study of different emerging disciplinary areas of disability studies in the social sciences, health sciences, humanities, business, and technology. Explores the connections between disability activism, art, and scholarship in the 21 century. Traces emerging regional distinctions in disability studies research and scholarship, especially between Northern and Southern Countries.

3 credits,

HAX 669: Disability and Health in Local and Global Contexts  
Critically examines the experiences of people with disabilities in a local and global context and examines the connections between the two contexts. Utilizes policy documents, ethnographies, memoirs, program evaluations, and multi-media and provides the tools to critically evaluate local and global disability experiences as well as programs and interventions.

3 credits,
HAX 690: Independent Study in Health and Rehabilitation Sciences
Independent study proposals in health and rehabilitation sciences. Approval of independent study proposal and credit hours required prior to registration.
1-3 credits,
May be repeated for credit.

HAX 693: Directed Readings
Provides faculty directed readings and guided discussion to synthesize selected content related to the current course curriculum and/or to the students’ research interests. Through the guided readings, the students will learn foundational and advanced theoretical constructs that will be important underpinnings of their future studies and doctoral research. Specifically, studies may focus in the concentration areas of rehabilitation and movement science, disability studies or behavioral and community health. A critical analysis of readings may include theoretical constructs, methodologies, and/or interpretation of results. The course will include analytical writings and a summative paper.
3 credits,
May be repeated for credit.

HAX 699: Dissertation Research On Campus
Dissertation research under direction of advisor. Prerequisite: Advancement to candidacy (G5). Major portion of research must take place on SBU campus.
1-9 credits, S/U grading
May be repeated for credit.

HAX 700: Dissertation Research Off Campus- Domestic
Dissertation research under direction of an advisor. Prerequisite: Advancement to candidacy (G5). Major portion of research will take place off-campus, but in the United States and/or U.S. provinces. All international students must enroll in one of the graduate student insurance plans and should be advised by an International Advisor.
1-9 credits, S/U grading
May be repeated for credit.

HAY 500: Neuroscience for Physical Therapy
HAY 500: Nutrition for Physical Therapy
HAY 501: Growth and Development Across the Life Span
HAY 502: Psychosocial Aspects of Disability
HAY 503: Rehabilitation therapies
HAY 504: Neurological Physical Therapy I
HAY 505: Neurological Physical Therapy II

Stony Brook University Graduate Bulletin: www.stonybrook.edu/gradbulletin
GRADUATE COURSE DESCRIPTIONS

Fall 2024

a comprehensive and patient-centered plan of care. Skills will be developed through role playing, videotape analyses, and clinical patient experiences. Lab experiences will require written and verbal justification for student clinical decisions. Prerequisites: Second year summer courses

2 credits,

HAY 506: Neurological Physical Therapy III
The last of a series of three courses designed to prepare second year physical therapy students to evaluate and treat patients with neurological dysfunction during their clinical experiences. Offers continued practice and synthesis of examination data during the evaluation process, however, major emphasis is to develop and implement appropriate intervention strategies based on the best available evidence for people with neurological or neuromuscular disorders. Prerequisites: Second Year Fall Courses

4.5 credits,

HAY 507: Orthopedic Physical Therapy I
The first of three courses within the musculoskeletal sequence. Explores neuromusculoskeletal concepts within the patient/client management model. Introduces orthopedic physical therapy practice emphasizes clinical decision-making and problem solving through on-going hypothesis generation and testing. Provides content that students will apply to paper cases as they establish goals, organize subjective and objective exams, and practice screening skills. Information that is obtained during typical physical therapy exams is utilized in discussions to practice the evaluation and intervention process including ruling out red flags, identifying yellow flags, establishing a physical therapy diagnosis, developing a problem list, generating and implementing an intervention plan. Prerequisite: Second Year Fall Courses

4 credits,

HAY 509: Pediatric Physical Therapy
Emphasizes the study of atypical movement patterns in children. Presents developmental and long-term effects of neuromuscular and musculoskeletal dysfunction as they relate to movement. Students learn examination and interventions for subtle and complex movement dysfunctions resulting from a variety of musculoskeletal and neuromuscular diagnoses, conditions, and syndromes including but not limited to preterm birth, torticollis, developmental hip dysplasia, OBPI, cerebral palsy, Down syndrome, autism, developmental coordination disorder (DCD), Spina Bifida and Duchenne Muscular Dystrophy. Explores strategies for working with children presenting at the opposite ends of functional abilities (severe/multiple vs minimal handicapping conditions. Addresses the role of the physical therapist during transitions between delivery settings. Prerequisite: Second Year Fall Courses

4.5 credits,

HAY 512: Prosthetics and Orthotics in Physical Therapy
Provides a theoretical knowledge base as a framework for clinical intervention when providing treatment using orthotic and/or prosthetic devices for clients across the lifespan who present with amputations, diabetes, neurological disorders, and pathokinesiologic deficits of the musculoskeletal system. Presents course materials that reinforces course work from previous courses, apply that information in a clinically relevant manner, and critically solve problems covering client examination, evaluation, diagnosis, and treatment when presented with a variety of clinical scenarios. Prerequisites: First Year Fall Courses

3 credits,

HAY 513: Orthopedic Physical Therapy II
The second of three courses within the musculoskeletal sequence. Explores neuromusculoskeletal concepts within the patient/client management model. Evaluation skills are sharpened as clinical decision-making and differential physical therapy diagnosis, prognosis and intervention are introduced in the framework of neuromusculoskeletal dysfunction. These general skills are then applied to various neuromusculoskeletal dysfunctions of the lower extremity. Functional anatomy, including the osteokinetemetics, arthrokinetemetics, myology and neurology of the lower extremity are explored as they relate to surgical and non-surgical neuromusculoskeletal conditions. Prerequisites: Second Year Summer Courses

2 credits,

HAY 515: Foundations of Kinesiology
Explores the essential topics of Kinesiology and establishes a basis for future study of applied kinesiology. Introduces the study of normal human movement including topics such as movement description, muscle function, and biomechanics.

1 credit,

HAY 517: Exercise Physiology
Provides a general background in exercise physiology. Topics include an introduction to energy systems and how they are recruited during different forms of exercise; an introduction to cardiopulmonary physiology and the response to exercise challenge; and the monitoring of cardiorespiratory and temperature vitals. Students will be expected to gain a general understanding of skeletal muscle physiology and recruitment, describe aerobic and anaerobic training effects, and understand exercise stress testing and prescription. Prerequisites: First Year Summer Courses

1 credit,

HAY 518: Foundations of Exercise and Movement in PT
Presents an introduction to the fundamental principles of strength and flexibility. Fundamentals of muscle and connective tissue function from microstructure to macrostructure are considered in health and dysfunctional states through the life span. These basic principles will be expanded to explore the concept of myofascial mobility, extensibility and length. Explores muscle function including strength, muscle endurance, power, and control throughout the trunk and extremities. Students will combine the skills learned in Kinesiology with those learned in this course to begin the process of examination, evaluation and designing intervention programs for the movement dysfunction. Prerequisites: First Year Summer Courses

3.5 credits,
HAY 519: Kinesiology  
Explores the kinetics and kinematics of normal, purposeful human movement. Integrates knowledge of human anatomy, physiology and biomechanics as it applies to movement of the extremities and spinal column. Includes evaluation procedures such as manual muscle testing, measurement of joint range of motion, and gait assessment. Direct patient contact is scheduled. Prerequisites: First Year Summer Courses 4.5 credits.

HAY 524: Health, Wellness and Prevention in Physical Therapy  
Presents issues related to promotion of health and wellness and concepts of integrative, complementary and preventive medicine. Examines and integrates general fitness, nutrition and complementary medicine into exercise prescriptions for the following chronic diseases and conditions: cardiovascular disease; endocrinology and metabolic disorders; pulmonary disease; oncology; disease; endocrinology and metabolic diseases and conditions: cardiovascular, cardiopulmonary, and integumentary systems. Discusses medical and surgical management. Prerequisites: First Year Summer Courses 4.5 credits.

HAY 525: Advanced Therapeutic Exercise  
Provides students with the opportunity to apply and analyze therapeutic exercise techniques in order to formulate exercise programs for diverse patient and client populations. Students will be encouraged to discuss and build upon their knowledge of basic therapeutic techniques attained from previous coursework and clinical training experiences. Advanced techniques will be demonstrated and practiced in lab. Students will evaluate, set goals, develop therapeutic exercise programs and measure outcomes. Issues regarding frequency, intensity and duration of treatment will be discussed throughout the course. Prerequisites: Second Year Courses 3 credits.

HAY 526: Clinical Medicine and Pharmacology I  
Provides a foundation in medicine and differential diagnosis. Introduces the concepts of the International Classification of Functioning, Disability and Health (ICF), the Patient/Client Management Model and outcomes management that guide the process of clinical decision-making. Integrates principles of pharmacology, medical imaging and laboratory diagnostic testing to facilitate safe and effective patient management. Familiarizes students with medical terminology and abbreviations for efficient and effective chart review and documentation. Common health conditions will be explored, focusing on epidemiology, pathophysiology, histology, as well as primary and secondary clinical characteristics. Discusses medical and surgical management and integration to formulate appropriate physical therapy interventions, precautions and contraindications related to each common health condition. Prerequisites: First Year Summer Courses 5 credits.

HAY 527: Foundations of Patient Care  
Emphasizes patient care in the acute care environment. Prepares students for functional mobility training for patients in all settings. Applies the laws of physics to body mechanics in order to safely and effectively assist patients with bedside functional mobility training. Prepares students to effectively guard patients during ambulation and engage in gait training with assistive devices. Students will perform initial evaluations, create physical therapy plans of care, and use vital signs and lab data to guide clinical decision making. Engages students in simulation-based learning experiences and integrated clinical experiences with patients of varying diagnoses and complexity to prepare them for their first clinical education experience. Prerequisite: First Year Fall Courses 4 credits.

HAY 528: Clinical Medicine and Pharmacology II  
Continues to build a critical foundation for Clinical Education I and the remainder of the professional curriculum by establishing a foundation in medicine and differential diagnosis. Students are expected to utilize the concepts of evidence-based practice, the ICF model of disablement, and the Patient/Client Management Model as frameworks for clinical decision-making. In-depth exploration of frequently encountered health conditions across the life span will be the continuing format. Presents epidemiology, pathophysiology, etiology, clinical characteristics with subsequent medical, pharmacological and surgical management of each health condition. Students will continue to build a repertoire of medical terminology, medical abbreviations and clinical outcome measures to promote efficient and effective chart review and documentation. Prerequisites: First Year Fall Courses 3 credits.

HAY 534: Motor Learning and Motor Control  
Establishes a context for the major explanatory concepts applied to the issues of coordination and skill and learning. Foundational material from Neuroscience will support the application and theory addressed throughout the course. Uses academic rationalization and cognitive processing philosophies to develop and refine intellectual processes. Students learn from historical perspectives of motor control to develop skills necessary to pose and solve problems, to infer, to hypothesize, to locate needed resources for theoretically sound clinical judgments. Students read original research papers and current literature pertaining to motor learning, motor programs and dynamic pattern theory. Student will analyze papers examining loss of function related to disease or injury. Prerequisite: First Year Fall Classes 3 credits.

HAY 543: Integumentary and Vascular Physical Therapy  
Presents principles of skin anatomy and physiology, normal and abnormal wound healing, and the anatomy and role of both peripheral vascular system and lymphatic systems. Discusses physical therapy assessment and interventions. Includes focused practice in myofascial mobility and extensibility, lymphedema management, wound assessment, debridement, wound dressing choices, and other available modalities. Engages students in practical skills during interactive lab sessions to demonstrate competence and integrate information in a clinically relevant manner to provide a framework for future safe and effective intervention with clients. Prerequisite: First Year Fall Courses 2 credits.

HAY 544: Biophysical Agents in Physical Therapy  
Introduces various physical, mechanical and electrotherapeutic biophysical agents. Covers the role of such agents in the management of impairments and pathology involving the musculoskeletal, neuromuscular, cardiopulmonary, and integumentary systems. Explores evidence-based informed decision making for each of these agents through the analysis of appropriate literature. Prerequisites: First Year Summer Courses 3 credits.

HAY 545: Ethics and Health Care for Physical Therapists
Provides an overview of the ethics of health care in a rapidly changing society. Explores ethical issues surrounding health care changes and public health policy. Includes an overview of ethics within patient education and discusses the professional code of ethics and standards. Students will learn how to approach ethical dilemmas using theoretical frameworks and decision-making processes. Introduces the student to the ethics within physical therapy and other health care professions through the use of case studies. Includes a review of classic cases in health care ethics, involving issues such as euthanasia and organ transplants from an ethical, legal and historical perspective. Prerequisites: Second Year Courses

**2 credits,**

**HAY 552: Research Methods for Physical Therapists**

First of three courses designed to prepare students to search for and critically appraise scientific literature as well as understand the fundamentals of research methods, design, and statistics. Includes principles of evidence based practice, use of electronic data bases to search for evidence, research and measurement reliability and validity, research design, descriptive statistics, statistical inference, tests for experimental comparison, correlation, regression, and nonparametric tests. Addresses the relationship between statistics and research design by introducing relevant research articles in the healthcare field. Prerequisites: First Year Fall Courses

**3 credits,**

**HAY 557: Introduction to Evidence Based Practice**

Second of three courses that introduce the concepts of evidence informed decision making by exploring the evidence based practice (EBP) model and the five steps of the EBP process. Builds upon the integration of research concepts that allow for the critical analysis of varying levels of research literature. Review of physical therapy literature will be used as a tool to integrate critical inquiry skills, depth of knowledge, and related clinical significance. Prerequisite: Second Year Fall Courses

**1.5 credits,**

**HAY 558: Evidence Based Practice Seminar**

Final of three courses that explore a broad spectrum of research literature examining physical therapy practice. Literature will be used as a tool to integrate student's critical inquiry skills and depth of knowledge. Students judge the strength of the evidence of each paper and draw conclusions regarding its clinical significance. When lacking evidence, challenges student to suggest ways to strengthen the current evidence. Prerequisites: Second Year Courses

**1-3 credits,**

**May be repeated 3 times FOR credit.**

**HAY 560: Professional Practice I: Foundations**

First of two courses regarding the developing physical therapy professional. Discusses historical, ethical and legal foundations and current and emerging issues affecting change within the profession. Introduces the format and function of the APTA at the national and state levels. Examines the roles and responsibilities of the physical therapist, the physical therapist assistant and the physical therapist aide in the present healthcare environment. Explores dynamics of professional interactions with patients, families and other healthcare providers.

**1.5 credits,**

**HAY 561: Professional Practice II: Clinical Education**

Taught concurrently with theoretical and practical coursework in the curriculum to prepare the students for their first clinical experience. Offered before HAY 595 Clinical Education I to prepare students for patient and caregiver instruction and to provide students with knowledge of the roles and responsibilities of the student and the clinical instructor within the healthcare environment. Examines different learning and teaching styles and their effect on the learning environment. The fundamentals of teaching as they apply to patient education, professional inservices, and clinical education are presented and practiced. Students are introduced to aspects of verbal and nonverbal communication, with opportunity to work in small groups for application of these principles. Preparation for the first clinical education experience, specifically clinical site and academic program expectations, professional behavior, and student responsibilities, are discussed in detail. Prerequisites: Second Year Summer Courses

**1.5 credits,**

**HAY 580: Practicum**

A limited number of students may enroll in 3-6 credits of independent study in research, education, clinical practice, or management/administration. Each practicum project is uniquely designed to meet the needs of the student. Mentored by faculty with expertise in the area of study. Acceptable projects must include design, implementation and analysis phases. 3-6 credits by permission of the Program Director.

**3-6 credits,**

**May be repeated 3 times FOR credit.**

**HAY 589: Case Studies I**

Integrates material from prior coursework and focuses on development of communication skills during physical therapy interactions with patients and other members of the interdisciplinary team. Students will engage in simulation-based learning experiences to help them develop their communication skills related to building relationships, opening a discussion, gathering information, understanding the patient perspective, sharing information, reaching agreement, providing closure, demonstrating empathy, and communicating accurate information. Students will also develop their skills related to self-reflection and feedback. Prerequisites: First Year Courses

**S/F graded**

**HAY 590: Case Studies II**

Integrates material from prior coursework and requires students to hypothesize mechanisms of injury to develop an evidence-based evaluation plan for patients with orthopedic dysfunction. Students will engage in simulation-based learning experiences to help them understand the relationship between pathophysiology and signs and symptoms, choose and perform appropriate assessments, evaluate clinical data, determine a differential diagnosis, respond to changes in patient status, and make appropriate recommendations for interventions for patients with orthopedic dysfunction. Prerequisites: Second Year Fall Courses

**1 credit, S/F graded**

**HAY 595: Clinical Education I**

An eight-week full time clinical experience course and the first of four clinical experiences in the curriculum. Allows the student to apply and integrate the academic knowledge, skills, and professional behavior acquired in the curriculum. Students are expected to demonstrate advanced beginner to intermediate level competency in all categories of the Clinical Performance Instrument (CPI) at the conclusion of the course. A licensed physical therapist, with a minimum of one year clinical experience, will provide close supervision and guidance during the learning experience. Prerequisites: All coursework prior to HAY 595.

**8 credits, S/F graded**

**May be repeated 1 times FOR credit.**

**HAY 602: Issues in Health Care Administration**
Provides a theoretical basis of successful management principles, as well as practical implementation strategies for these principles as they apply to the field of physical therapy. Emphasizes the basic management principles of planning, organizing, leadership, and controlling/coordination; marketing theory; business plan development; change management, total quality management/continuous quality improvement; regulatory agency and public policy impact; enhancement and maintenance of quality care including outcome analysis; emerging health care reimbursement models; and consulting approaches. Prerequisites: Second Year Courses

1-3 credits, May be repeated 3 times FOR credit.

HAY 620: Cardiopulmonary Physical Therapy I
Introduces students to the interpretation of data from various diagnostic tests commonly encountered in patients with cardiac and/or pulmonary dysfunction. Engages classroom and laboratory activities designed to promote clinical decision making skills regarding the titration of exercise and the development of physical therapy interventions, including airway clearance techniques. Concentrates on the psychomotor skills needed to treat this patient population and the clinical reasoning skills required to ensure patient safety and improve patient outcomes. Prerequisites: Summer Year 2 Courses 2 credits.

HAY 621: Cardiopulmonary Physical Therapy II
Integrates material from prior coursework and utilizes information to develop an evidence-based total plan of care for patients with cardiac and/or pulmonary dysfunction. Students engage in simulation-based learning experiences to help understand the relationship between pathophysiology and signs and symptoms; choose and perform appropriate assessments; evaluate clinical data; design and perform physical therapy interventions; respond to changes in patient status; and make appropriate recommendations for equipment and community programs for patients with cardiac and/or pulmonary dysfunction. Prerequisites: Summer Year 3 courses. 2 credits.

HAY 692: Clinical Education II
A nine-week full time clinical experience course and the second of four clinical experiences in the curriculum. Allows the student to apply and integrate the academic knowledge, skills, and professional behavior acquired in the curriculum. Students are expected to demonstrate intermediate level competency in all categories of the Clinical Performance Instrument (CPI) at the conclusion of the course. A licensed physical therapist, with a minimum of one year clinical experience, will provide close supervision and guidance during the learning experience. Prerequisites: All coursework prior to HAY 692. 9 credits, S/F graded

HAY 693: Clinical Education III
An eight-week full time clinical experience course and the third of four clinical experiences in the curriculum. Allows the student to apply and integrate the academic knowledge, skills, and professional behavior acquired in the curriculum. Students are expected to demonstrate intermediate level competency in all categories of the Clinical Performance Instrument (CPI) at the conclusion of the course. A licensed physical therapist, with a minimum of one year clinical experience, will provide close supervision and guidance during the learning experience. Prerequisites: All coursework prior to HAY 693. 8 credits, S/F graded

HAY 694: Clinical Education IV
A full time ten-week clinical experience course and the final clinical experience in the curriculum. Allows the student to apply and integrate the academic knowledge, skills, and professional behavior acquired in the curriculum. Students are expected to demonstrate entry level competency in all categories of the Clinical Performance Instrument (CPI) at the conclusion of the course. A licensed physical therapist, with a minimum of one year clinical experience, will provide close supervision and guidance during the learning experience. Prerequisites: All coursework prior to the HAY 694. 8-12 credits, S/F graded

HAY 699: Clinical Continuation
This course is for physical therapy students continuing with clinical. S/F graded May be repeated for credit.

HBA

Anatomical Sciences

HBA 521: Gross Anatomy of Head, Neck, and Trunk
Tutorial laboratories with emphasis on dissections of the human head, neck, and trunk. 8 credits, Letter graded (A, A-, B+, etc.)

HBA 541: Evolutionary Anatomy
A lecture and laboratory course that includes dissections of the entire human body. The course is organized in three modules: (1) thorax and abdomen, (2) head and neck, including neuroanatomy, and (3) limbs. It covers regional and conceptual information on the gross anatomy of all organ systems in the human body. There is a lab fee associated with this course. Summer, 5 credits, Letter graded (A, A-, B+, etc.)

HBA 544: Human Anatomy for Physical Therapists
A lecture and laboratory course that includes dissections of the entire human body. The course is organized in three modules: (1) thorax and abdomen, (2) head and neck, including neuroanatomy, and (3) limbs. It covers regional and conceptual information on the gross anatomy of all organ systems in the human body. There is a lab fee associated with this course. 8 credits, Letter graded (A, A-, B+, etc.)
conjunction with HYA519, Kinesiology for Physical Therapists. This module will offer an expanded view of the functional anatomy and arthrology of the hip, thigh, leg and foot. Labs will be three hours, one day per week. Enrollment will be limited to DPT students.

Fall, S/U grading

HBA 550: Vertebrate Evolution
Survey of the fossil record of vertebrate evolution. The course emphasizes the origin, phylogeny, comparative and functional morphology, biogeography, and paleontology of vertebrate animals. Laboratory included. The lectures and laboratories will utilize an extensive collection of comparative anatomical material, fossil casts, and slides.

Spring, alternate years, 4 credits, Letter graded (A, A-, B+, etc.)

HBA 551: Phylogenetic Systematics, Biogeography and Comparative Methods
This course will provide students with a familiarity in the practical application of modern phylogenetic methods and the use of phylogenies in framing evolutionary hypotheses. The course will have both a lecture and laboratory component with lectures including in-class discussions of assigned readings. Lab exercises will be devoted to hands-on experience with available software for phylogenetic and comparative methods. Comparative methods examined will include a focus on historical biogeography as well as ancestral state reconstruction, rates of evolution and diversification, and analysis of adaptation and key innovations.

Spring, 4 credits, Letter graded (A, A-, B+, etc.)

HBA 560: Regional Anatomy for non-Healthcare students
A lecture and laboratory course that includes dissections of the entire human body covering regional and conceptual information on the gross anatomy of all organ systems in the human body. In the Fall, this course is presented in conjunction with The Body Course (MED 500A); in the Summer, it is presented in conjunction with Advanced Regional Anatomy for Physical Therapists and for Physician Assistants (HBA 540 and 561). There is a lab fee associated with this course. This course is not for students in a Healthcare Professional Program. Prerequisite: Permission of Instructor

Fall, Summer, 3-8 credits, Letter graded (A, A-, B+, etc.)

HBA 561: Human Gross Anatomy for Physician Assistants
A lecture and laboratory course that includes dissections of the entire human body. The course is organized in three modules: (1) thorax and abdomen; (2) head and neck, including neuroanatomy; and (3) limbs. It covers regional and conceptual information on the gross anatomy of all organ systems in the human body. There is a lab fee associated with this course.

Summer, 5 credits, Letter graded (A, A-, B+, etc.)

HBA 563: Aspects of Animal Mechanics
An introduction to biomechanics. Covers freebody mechanics and kinetics as applied to vertebrate locomotion. Considers the structure and physiology of muscle as it relates to adaptations of the musculoskeletal system. This course is offered as both HBA 563 and DPA 563.

Prerequisites: Introductory physics and biology or permission of instructor.

Spring, odd years, 2 credits, Letter graded (A, A-, B+, etc.)

HBA 564: Primate Evolution
The taxonomic relationships and evolutionary history of primates as documented by their fossil record and structural and chemical evidence. Emphasis on primates prior to the origin of the human lineage. This course is offered as ANT 564, DPA 564 and HBA 564.

4 credits, Letter graded (A, A-, B+, etc.)

HBA 565: Human Evolution
A survey of the fossil record of hominin evolution through the Pliocene and Pleistocene with emphasis on the morphological structure and function of locomotor, masticatory, and neural systems. Includes utilization of comparative anatomical material and an extensive cast collection. This course is offered as ANT 565, DPA 565 and HBA 565.

4 credits, Letter graded (A, A-, B+, etc.)

HBA 566: Studies in Functional Morphology
Introduction to the theory and methods of functional morphology. Various methods of analysis and the application of experimental techniques such as electromyography or bone strain analysis are discussed as they pertain to the understanding of the interaction between form and function. Special emphasis is placed on the analysis of human and nonhuman primate morphology, and the application of this analysis to interpretation of the fossil evidence for human and nonhuman primate evolution. This course is offered as both HBA 566 and DPA 566.

Prerequisite: Permission of instructor.

Spring, even years, 2 credits, Letter graded (A, A-, B+, etc.)

HBA 582: Comparative Primate Anatomy
The comparative anatomy of living primates. Laboratory dissection with emphasis on relating structural diversity to behavior and biomechanics. This course is offered as both HBA 582 and DPA 582.

4 credits, Letter graded (A, A-, B+, etc.)

HBA 590: Projects in Anatomical Sciences
Individual research projects on anatomical sciences topics closely supervised by faculty members to be carried out in staff research laboratories.

Fall and Spring, 1-6 credits, S/U grading

May be repeated 4 times FOR credit.

HBA 690: Graduate Seminar
Seminars by graduate students on current literature in the areas of the anatomical sciences.

Fall and Spring, 1-2 credits, S/U grading

May be repeated 3 times FOR credit.

HBA 692: Advanced Topics in Anatomical Sciences Literature
Tutorial readings in anatomical sciences with periodic conferences, reports and examinations arranged with the instructor.

Fall and Spring, 1-4 credits, S/U grading

May be repeated for credit.

HBA 695: Practicum in Teaching
Practical instruction in the teaching of anatomical sciences carried out under faculty supervision. 1-4 credits, S/U grading

May be repeated for credit.

HBA 699: Dissertation Research on Campus
Original investigation under supervision of thesis adviser and committee.

Fall, Spring, and Summer, 1-9 credits, S/U grading

May be repeated for credit.

HBA 700: Dissertation Research off Campus - Domestic
Preactice(s): Must be advanced to candidacy (G5). Major portion of research will take place off-campus, but in the United States and/
or U.S. provinces. Please note, Brookhaven National Labs and the Cold Spring Harbor Lab are considered on-campus. All international students must enroll in one of the graduate student insurance plans and should be advised by an International Advisor.

**Fall, Spring, 1-9 credits, S/U grading May be repeated for credit.**

**HBA 701: Dissertation Research off Campus - International**
Prerequisite(s): Must be advanced to candidacy (G5). Major portion of research will take place outside of the United States and/or U.S. provinces. Domestic students have the option of the health plan and may also enroll in MEDEX. International students who are in their home country are not covered by mandatory health plan and must contact the Insurance Office for the insurance charge to be removed. International students who are not in their home country are charged for the mandatory health insurance. If they are to be covered by another insurance plan they must file a waiver be second week of classes. The charge will only be removed if other plan is deemed comparable.

**Fall, Spring, 1-9 credits, S/U grading May be repeated for credit.**

**HBA 800: Full-Time Summer Research**
Full-time laboratory research projects supervised by staff members. 0 credit, S/U grading
S/U grading
May be repeated for credit.

**HBC**

**Biochemistry**

**HBC 531: Molecular Foundations of Medicine**
An integrated course covering the important aspects of biochemistry, cell biology, human and molecular genetics, and histology. Includes lectures, small group conferences and laboratories and stresses the clinical relevance of the basic science material.

8 credits, Letter graded (A, A-, B+, etc.)

**HBH**

**Pharmacology**

**HBH 501: Principles of Pharmacology**

Autonomic, Smooth Muscle and CNS Pharmacology. Pharmacology of specific drugs of historical interest including alcohol, antibiotics, aspirin, nicotine and morphine. Review of anticoagulants & thrombolytic agents, antiparasitic, and drugs for the treatment of allergic conditions and gout. Includes discussion of specific cases taken from clinical practice and a presentation based on a set of selected readings. Cross-listed with BCP 401

**Fall, 4 credits, Letter graded (A, A-, B+, etc.)**

**HBH 502: Advanced Principles of Pharmacology**

**Spring, 4 credits, Letter graded (A, A-, B+, etc.)**

**HBH 505: Pharmacology to Pharmacy: Practical Clinical Aspects for Non-Doctors (Didactic)**
This course, to be offered exclusively online, is designed for students interested in health care (either basic medical science-oriented or clinical). The class introduces many aspects of clinical pharmacology, but is geared toward non-clinicians. Clinical Vignettes and case discussions will be presented. Several medical procedures will be first described and then demonstrated. Understanding these procedures will be integral to appreciating the vignettes and clinical case discussions. The multidisciplinary course faculty will include physicians, scientists, educators, nurses and pharmacists. Enrolled students will have the opportunity to ask questions directly through online chats.

0-3 credits, S/U grading

**HBH 506: Graduate Pharmacology Colloquium**
Research seminars in pharmacology and toxicology presented by faculty and distinguished scientists from academic and industrial institutions. A 1 hr. Journal Club/Discussion Session precedes seminar to review a reference paper relevant to the research concepts to be presented. Students are expected to develop an understanding of the scientific principles given in the colloquium. Students are required to give a formal presentation. Co-scheduled with BCP 406. Offered

Spring, 2 credits, Letter graded (A, A-, B+, etc.)

May be repeated 1 times FOR credit.

**HBH 510: Practical Clinical Exposure for Translational Basic Scientists**
Hospital Clinical Rotations-Physician
Course faculty will arrange two, two-week-long rotations (four weeks total). The following services are committed to participate: Anesthesiology-students will be offered opportunities in operating room (OR) observation; pre-admission patient evaluations; pain management clinic; and others depending upon availability. Internal Medicine-students will be offered opportunities in the medical intensive care unit (MICU); coronary care unit (CCU); medical oncology; and others depending upon availability. Others-depending upon availability. Student will be expected to spend 3-4 hours daily in their assigned clinical activites (15-20 hours weekly; 60-80 hours for the course). In addition, they will be asked to participate in special medical exercises arranged for them on an ad hoc basis by course faculty, both in the hospital pharmacy and elsewhere. Finally all students will attend weekly case conferences, 2hr each for all 4 weeks. At these conferences, students will be asked to prepare and present two clinical cases, based on two of the patients they have seen on their clinical rotations. It is expected that each student will be responsible for at least two presentations during the four-week course. Presentations will be graded by course faculty, S (satisfactory) or U (unsatisfactory). The final grade for the course, also S or U, will be determined both by these grades as well as by overall attendance at all course activities.

0-3 credits, S/U grading

May be repeated for credit.

**HBH 531: Pharmacology-Dental**
Basic principles that underlie actions of drugs on physiological processes with particular reference to their therapeutic and toxic actions. For medical and dental students. Prerequisites: Physiology, biochemistry, permission of instructor and admission to Graduate Health Sciences Center Program. Modules 4-6, 5 credits, Letter graded (A, A-, B+, etc.)

**HBH 545: Biochemical Laboratory Techniques**
Introduces theoretical principles and experimental techniques used in modern biochemical research. Lectures and homework assignments explore topics in basic molecular
and cellular techniques. Prerequisites: Admission to Health Sciences Center program. 
Fall, 1 credit, Letter graded (A, A-, B+, etc.) 
May be repeated 2 times FOR credit. 

**HBH 546: Biochemical Laboratory Techniques** 
Continuation of HBH545. Lectures and demonstrations present topics in chromatography, mass spectrometry, protein sequencing, sedimentation, electrophoresis, ligand binding, basic pharmacological methods and statistical analysis of data. Includes procedures for the safe handling of toxic chemicals and radioisotopes. Prerequisites: Permission of instructor, admission to graduate Health Sciences Center program. 
Spring, 1 credit, Letter graded (A, A-, B+, etc.) 
May be repeated 2 times FOR credit. 

**HBH 549: Legal & Regulatory Issues in Clinical Research combined with Ethics & Professionalism in Clin. Resch.** 
Some of the sessions are part of the SBU course on Responsible Conduct of Research and Scholarship (RCRS, formerly known as GRD 500). During the course, major contemporary issues in legal and regulatory arenas associated with scientific research are discussed. The course introduces students to the history behind the regulations that safeguard human subjects, and educates students in detail about their responsibilities as clinical investigators. Using an interactive case based format the topics covered include: justification for human research and reasonable balance of risk versus benefits; the use of animals in research; informed consent; the ethical challenges of clinical research; ethical concerns associated with genetic testing and screening; research in minors and adults of questionable capacity to consent; conflict of interest; investigator responsibilities with regard to fulfilling government regulation; scientific fraud and whistle blowing; the scientific community and mentoring; authorship and attribution; special populations and inclusion of minorities; and emergency research-related special requirements. 
1 credit, S/U grading 
May be repeated for credit. 

**HBH 560: Proposal Preparation in Regulatory Biology** 
A literature-based course focusing on major research areas in molecular and biochemical pharmacology. The first part of the course will expose students to a series of examples of recent grant proposals. The second part of the course will feature student presentations of their research proposals. Due to the coordination of this course with the Qualifying Exam, registration is limited to Pharmacology graduate students. 
Fall and Spring, 2 credits, S/U grading 
May be repeated 2 times FOR credit. 

**HBH 560: Selected Topics in Pharmacology** 
Student seminars and readings on topics arranged through consultation with staff. 
0-1 credits, Letter graded (A, A-, B+, etc.) 
May be repeated for credit. 

**HBH 565: Advanced Structural Biology/Structural Methods in Drug Discovery** 
This course is designed for students that want to gain theoretical and practical experience in macromolecular structure determination through NMR spectroscopy and/or X-ray crystallography. The course is organized into two modules; NMR spectroscopy and X-ray crystallography. Students may elect to take one or both modules. Emphasis will be placed on practical aspects of structural determination, including sample preparation, data collection and processing. In each of the modules, students will be guided through a complete structural determination project. A final project report per module will be required. Familiarity with Linux is desirable. Students are encouraged to contact instructors prior to enrolling. Crosslisted as SSB580 and HBH585. 
Spring, 0-4 credits, S/U grading 

**HBH 590: Pharmacology Seminars** 
Advanced research seminars by staff and visiting lecturers. 
Prerequisites: Full-time pharmaceutical graduate status 
Fall and Spring, 0-1 credits, S/U grading 
May be repeated for credit. 

**HBH 599: Graduate Research in Pharmacological Sciences** 
Original research projects under faculty supervision. 

Prerequisites: Full-time pharmacology graduate status 
Fall, Spring, and Summer, 0-12 credits, Letter graded (A, A-, B+, etc.) 
May be repeated for credit. 

**HBH 601: Practicum in Teaching Pharmacology** 
Practical experience and instruction in the teaching of pharmacology carried out under faculty orientation and supervision. 
Prerequisites: Full-time pharmacology graduate status 
Fall and Spring, 0-1 credits, S/U grading 
May be repeated 5 times FOR credit. 

**HBH 631: Graduate Pharmacology I** 
Basic principles of pharmacology will be discussed including pharmacokinetics and pharmacodynamics in both normal and various disease states. Major problems in human pharmacology will be considered including obesity, diabetes, hypertension and heart failure. Underlying physiology as well as pathophysiologic background will be presented. Drug design and development will be discussed from both scientific and socio-economic perspectives. 
Prerequisites: Graduate Biochemistry, Physiology HBY 561 or consent of instructor. 
Fall and Spring, 3 credits, Letter graded (A, A-, B+, etc.) 
May be repeated 2 times FOR credit. 

**HBH 632: Graduate Pharmacology II** 
This course introduces second-year graduate students to chemotherapy agents used to combat bacterial and viral infections as well as cancers. The course develops a detailed understanding of the strategies involved in identifying drug targets in these two diverse therapeutic settings. The antibacterial lectures emphasize the problem of drug resistance and the need to develop new agents to combat resistant organisms. The anti-cancer lectures begin with a comprehensive analysis of the molecular basis of cellular transformation leading to neoplastic disease. Lectures on cancer therapy emphasize the contrast between conventional cytotoxic chemotherapy and novel therapeutic approaches guided by recent developments in cancer research. Novel computational biology and structural biology approaches are featured throughout the course. Each student is expected to make two formal journal-club style presentations during the course and to actively participate in group discussion. 
0-3 credits, Letter graded (A, A-, B+, etc.) 
May be repeated 2 times FOR credit.
HBH 633: Quantitative Methods in Pharmacology
This course introduces second-year graduate students to the quantitative approaches that underlie modern research in Pharmacology. Students will be exposed to tools and techniques that are widely applied in different fields of biomedical research. Students will receive an introduction to the command line, coding and statistics, and learn to apply these tools to pharmacokinetic compartmental analysis, molecular modeling, image analysis, structural biology, biological big data analysis and genomics. Students will be actively engaged in data analysis and will be expected to participate in group discussion.

3 credits,

HBH 655: Neuropharmacology
An advanced course for graduate students interested in developing an understanding of neuropharmacology and research on this topic. Following a general introduction to the nerve cell structure, synaptic and chemical transmission, three themes receptors, receptors as channels, and G-protein-coupled receptors are developed. Recent advances in cell and molecular biology provide the framework for instruction and discussion. This course is offered as both HBH 655 and BNB 655. Prerequisite: Admission to Graduate Health Sciences Center Program.

Spring, 3 credits, Letter graded (A, A-, B+, etc.)

HBH 656: Cell Biology
Introduction to the structural and functional organization of cells and tissues and to the way structure relates to function. Particular emphasis is placed on nuclear and chromosomal structure, signal transduction, protein translocation, the cytoskeleton and the extracellular matrix. The interaction of cellular structures and components and their regulation is stressed as is the organization and interaction of cells in tissues. The course is comparative and includes examples of cells and tissues from vertebrates, invertebrates, plants, and prokaryotic systems. Prerequisite: matriculation in graduate program or permission of instructor.

Spring, 3-4 credits, Letter graded (A, A-, B+, etc.)

May be repeated for credit.

HBH 699: Dissertation Research in Campus
Original investigation undertaken as part of the Ph.D. program under supervision of thesis adviser and committee. Prerequisite: Advancement to candidacy (G5); permission of thesis advisor. Major portion of research must take place on SBU campus, at Cold Spring Harbor, or at the Brookhaven National Lab.

Prerequisite: Full-time pharmacology graduate status

Fall, Spring, and Summer, 0-9 credits, S/U grading

May be repeated for credit.

HBH 700: Dissertation Research off Campus - Domestic
Prerequisite: Must be advanced to candidacy (G5). Major portion of research will take place off-campus, but in the United States and/or U.S. provinces. Please note, Brookhaven National Labs and the Cold Spring Harbor Lab are considered on-campus. All international students must enroll in one of the graduate student insurance plans and should be advised by an International Advisor.

Prerequisite: Full-time pharmacology graduate status

Fall, Spring, 1-9 credits, S/U grading

May be repeated for credit.

HBH 701: Dissertation Research off Campus - International
Prerequisite: Must be advanced to candidacy (G5). Major portion of research will take place outside of the United States and/or U.S. provinces. Domestic students have the option of the health plan and may also enroll in MEDEX. International students who are in their home country are not covered by mandatory health plan and must contact the Insurance Office for the insurance charge to be removed. International students who are not in their home country are charged for the mandatory health insurance. If they are to be covered by another insurance plan they must file a waiver be second week of classes. The charge will only be removed if other plan is deemed comparable.

All international students must receive clearance from an International Advisor. Fall, Spring, 1-9 credits, S/U grading

May be repeated for credit.

HBH 800: Full-Time Summer Research
Full-time laboratory research projects supervised by staff members. Summer Term. Prerequisites: Full-time pharmacology graduate status.

S/U grading

May be repeated for credit.

HBI

Radiation Oncology

HBI 599: Graduate Research in Radiation Oncology Medical Physics
Original research projects under the faculty supervision in areas of medical physics relating to radiation oncology.

1-8 credits, Letter graded (A, A-, B+, etc.)

HBM

Molecular Genetics and Microbiology

HBM 503: Molecular Genetics
Introduces the classical work and current developments in lower and higher genetic systems. Covers gene structure and regulation in prokaryotic and eukaryotic organisms, mutational analysis and mapping, transposable elements, and biological DNA transfer mechanisms. Bacteriophage as well as lower and higher eukaryotic systems are used to illustrate aspects of molecular genetic structure and function. This course is offered as both MCB 503 and HBM 503. Prerequisite: matriculation in graduate program or permission of instructor

Fall, 3 credits, Letter graded (A, A-, B+, etc.)

HBM 509: Experimental Microbiology and Immunology
An introduction to modern microbiological research. The selection of laboratories is made in consultation with the student's advisory committee. By taking part in ongoing projects the student will learn experimental procedures and techniques and become acquainted with research opportunities in the department.

Prerequisites: Matriculation in a graduate program and permission of the graduate studies director and the lab director

Fall, 1-8 credits, S/U grading

HBM 510: Experimental Microbiology and Immunology: Lab II
An introduction to modern microbiological research. The selection of laboratories is made in consultation with the student's advisory committee. By taking part in ongoing projects the student will learn experimental procedures and techniques and become acquainted with research opportunities in the department.

Prerequisites: Matriculation in a graduate program and permission of the graduate studies director and the lab director

Spring, 1-8 credits, S/U grading

HBM 522: Biology of Cancer
A short course with the emphasis on cancer as a disease of man. Lectures address human cancer as seen by the clinician and as basic
A course, based upon the literature in molecular genetics and microbiology, to instruct students in scientific writing and the preparation of research proposals. The course will be organized in three parts. In the first section of the course, students will become familiar with the components of the research proposal and will read and evaluate proposals written by the training faculty. Lectures given by the course co-directors will cover the basics of scientific writing, research proposal preparation and the problems and concerns commonly voiced by reviewers of research proposals. In the second section, students will develop two short proposals in the area of molecular genetics and microbiology that are unrelated to their graduate research. One of these short proposals will be selected for development into a full proposal. In the third section, students will develop and write the full proposal. The students' skills in proposal preparation will be enhanced by critiquing the short and full proposals presented by other students in the second and third sections of the course.

**Offered**

*Spring, 1-3 credits, Letter graded (A, A-, B+, etc.)*

**HBM 696: Professional Development in Microbiology and Immunology**

In a joint credit-bearing course, 12 students (at the advanced Bachelor and beginning Master level) from three partner institutions will develop a 360° view of six different pandemics that occurred in human history. Tuberculosis, Influenza, Dengue, SARS/Covid 19, HIV, antimicrobial resistance. Each pandemic will be covered by one expert who also serves as a mentor for the students. Expert-mentors will be recruited from the partners; networks. Six international student pairs will each explore one pandemic and compare its consequences as well as measures taken against them in different parts of the world. In addition, students will gain insights into public health institutions (WHO, CDC, RKI etc.). Students will get different perspectives on pandemics, which are of global concern, while measures against them are usually taken on a national level.

*1-2 credits, Letter graded (A, A-, B+, etc.)*

**HBM 699: Dissertation Research in Microbiology and Immunology**

For the student who has been advanced to candidacy (G5); permission of dissertation advisor.

*Fall, Spring, and Summer, 1-9 credits, S/U grading*

*May be repeated for credit.*

**HBM 700: Dissertation Research off Campus - Domestic**

Prerequisite: Must be advanced to candidacy (G5). Major portion of research will take place off-campus, but in the United States and/or U.S. provinces. All international students must enroll in one of the graduate student insurance plans and should be advised by an International Advisor.

*Fall, Spring, Summer, 1-9 credits, S/U grading*

*May be repeated for credit.*

**HBM 701: Dissertation Research off Campus - International**

Prerequisite: Must be advanced to candidacy (G5). Major portion of research will take place outside of the United States and/or U.S. provinces. Domestic students have the option of the health plan and may also enroll in MEDEX. International students who are in their home country are not covered by mandatory health plan and must contact the Insurance Office for the insurance charge to be removed. International students who are not in their home country are charged for the mandatory health insurance. If they are to be covered by another insurance plan they must file a waiver be second week of classes. The charge will only be removed if other plan is deemed comparable.

*All international students must received clearance from an International Advisor. Fall, Spring, 1-9 credits, S/U grading May be repeated for credit.*

**HBM 800: Full-Time Summer Research**

Full-time laboratory research projects supervised by staff members.
0-1 credits, S/U grading
May be repeated for credit.

**HBP**

**Pathology**

**HBP 511: Pathobiology for Graduate Health Care Practitioners**

For graduate students who have obtained primary health care baccalaureate degrees through the case study approach. Covers the underlying principles of modern experimental pathology. Focuses on the clinical aspects of the body system, including relevant underlying biochemistry, structure, or pathophysiology at the organ, tissue, cell or molecular level.

**Prerequisites:** Undergraduate degree, health care experience, biochemistry or cell biology, anatomy and microbiology.

**Fall and Spring, 3 credits, Letter graded (A, A-, B+, etc.)**

**HBP 533: Immunology**

Principles of immunology for graduate students in the biological sciences, including definition of antigens and antibodies, specificity of the immune response, immunoglobulin structure, the genetics of immunoglobulin synthesis, cellular cooperation in the immune response, hypersensitivity, tolerance immunogenetics. Open to advanced undergraduates.

**Fall, 3 credits, Letter graded (A, A-, B+, etc.)**

**HBP 556: Laboratory Medicine**

A four-week full-time (6 hr, day) course dealing with clinical laboratory decision making and the basis for the laboratory evaluation of human evaluation of human disease. Didactic and practical presentations by interdepartmental faculty. Intended principally for senior medical students, but also for advanced microbiology or biochemistry students interested in clinical applications.

**Prerequisite:** Permission of instructor.

**Spring, 6 credits, Letter graded (A, A-, B+, etc.)**

**HBP 590: Seminars in Immunology**

A series of monthly seminars focusing on research in progress by the participants, current journal articles in the field of immunobiology, and prepared reviews of specified areas in the general field.

**Prerequisite:** MCB Graduate Students

**Fall and Spring, 1 credit, S/U grading**

**May be repeated for credit.**

**HBP 622: Clinical Pathologic Correlations: Gross Pathology**

Correlative exercises in clinical pathology and human gross anatomic pathology including surgical biopsy material. Open to students in medical sciences.

**Prerequisites:** Systems pathology and general pathology course. Permission of instructor.

**Fall, 1-3 credits, Letter graded (A, A-, B+, etc.)**

**May be repeated for credit.**

**HBP 691: Journal Club in Pathology**

Provides students with a forum for acquiring skills involved in the critical analysis and presentation of scientific data by active participation in seminars of major topics in cellular and molecular pathology, and critical discussion of selected topics with presentation of papers from the literature.

**Prerequisite:** MCB Graduate Student

**Fall and Spring, 1 credit, Letter graded (A, A-, B+, etc.)**

**May be repeated for credit.**

**HBP 966: Hematology Conference**

Teaches a given aspect of hematology, oncology or immunology. Staff from medicine, pathology, and nuclear medicine participate, and usually presents a case to introduce the subject. Various teaching aids, such as review and usually presents a case to introduce the subject. Various teaching aids, such as review

**Fall and Spring, 1 credit, Letter graded (A, A-, B+, etc.)**

**May be repeated for credit.**

**HBP 967: Tumor Conference**

Considers problems in the management of each patient including a review of a malignancy and usually presents a case to introduce the subject. Various teaching aids, such as review

**Fall and Spring, 1 credit, Letter graded (A, A-, B+, etc.)**

**May be repeated for credit.**

**HBP 968: Advanced Clinical Pathologic Correlations: Gross Pathology**

Postgraduate correlative exercises in human gross pathologic anatomy that emphasize the gross pathologic basis for altered function and clinical manifestations of disease. Open to physicians and others with advanced degrees in medical sciences.

**1-3 credits, Letter graded (A, A-, B+, etc.)**

**May be repeated for credit.**

**HBP 969: Anatomical and Surgical Pathology for Residents in Pathology**

To provide practical and clinical experience in tissue pathology. During the four week elective the student is given the opportunity to participate in all aspects of autopsies as well as gross and microscopic examination of surgical specimens. There is ongoing review of general and organ system pathologic correlations. This elective is selected by students who plan a career in pathology as a "hands-on" introduction to the specialty. The elective is also chosen by others, particularly individuals who will enter radiology, and who seek to correlate radiographic and pathologic anatomy. Students who are interested and motivated may become involved in relatively independent work-up of selected cases. Primarily for health sciences professionals.

**1-3 credits, Letter graded (A, A-, B+, etc.)**

**May be repeated for credit.**

**HBP 971: Renal Clinicopathologic Correlations**

A case-oriented, postgraduate course in renal biopsy interpretation and its relationship to patient management.

**1 credit, Letter graded (A, A-, B+, etc.)**

**May be repeated for credit.**

**HBY**

**Physiology and Biophysics**

**HBY 500: Short Term Research Projects in Physiology and Biophysics**

Short term research project (rotation) under the supervision of a staff member.

**Prerequisite:** Must be a Graduate Students in the Dept. of Physiology & Biophysics.

**Spring, 1-12 credits, Letter graded (A, A-, B+, etc.)**

**May be repeated 4 times FOR credit.**

**HBY 501: Physiology**

Introduces normal function of human tissues and organs and their regulation by nervous and endocrine systems. Emphasizes the organization and function of physiological control systems and the maintenance of a constant internal environment. Enrollment restricted to fully matriculated graduate students, with permission of instructor. Only Fall.

**4 credits, Letter graded (A, A-, B+, etc.)**

**HBY 530: Cellular Physiology and Biophysics**

Cellular structure and function. Topics include ion channels, excitability, transport, energetics and metabolism, contraction, secretion, and communication within and between cells.
Emphasizes quantitative analysis of cellular processes.
1-3 credits, Letter graded (A, A-, B+, etc.)

**HBY 531: Medical Physiology**
A graduate-level introduction to the physiology of the organ systems with ultrastructural correlations. Ultrastructural correlations are demonstrated in a laboratory setting using histological preparations in conjunction with electron micrographs illustrating the relevant ultrastructure needed to understand the normal functioning of tissues and organs. The physiology of the major organ systems is addressed in a lecture format with the emphasis on problem solving. Relevant clinical correlations are addressed at the end of each block in so far as they illustrate how symptoms and signs of disease result from disordered physiology. Organ Systems addresses the structure and function of the cardiovascular, respiratory, renal, gastrointestinal, endocrine, skeletal, reproductive, and integumentary systems. Prerequisites: Admission to medical or dental school and permission of instructor. Only Spring.
8 credits, Letter graded (A, A-, B+, etc.)

**HBY 554: Principles of Neuroscience**
The aim of this course is to highlight and create an understanding as to how the human nervous system operates.
3 credits, Letter graded (A, A-, B+, etc.)

**HBY 557: Advanced Physiology**
This course is designed to introduce students to integrative approaches in biomedical research. Emphasis will be placed on the primary physiological concepts of control, communication, signal processing, metabolism and replication. Prerequisites: Systems Physiology, Biochemistry and Permission of Instructor.
Spring, 3 credits, Letter graded (A, A-, B+, etc.)

**HBY 561: Statistical Analysis of Physiological Data**
Statistical methods useful in analyzing common types of physiological data. Topics include probability, data distributions, hypothesis testing with parametric and non-parametric methods, ANOVA, regression and correlation, and power analysis. Emphasis is on experimental design and appropriate, efficient use of statistical software.
Offered
Spring, 1 credit, Letter graded (A, A-, B+, etc.)

**HBY 562: Model-based Analysis of Physiological Data**
The analysis of common biochemical and physiological data by non-linear regression of data models and biophysical models of physiological and biochemical processes. Examples include binding kinetics, compartmental mass transfer and spectral analysis.
Prerequisite: Permission of instructor, HBY 561
Fall, 1 credit, Letter graded (A, A-, B+, etc.)

**HBY 564: Experimental Techniques in Systems Physiology**
A series of lectures and laboratory exercises designed to introduce students to the experimental techniques used in systems physiology. Emphasis will be placed on the ethical use of rodents in biomedical research and the measurement of physiological variables. Data acquisition and analysis procedures used in cardiovascular, respiratory, neural, and renal physiology will also be covered. Only
2 credits, Letter graded (A, A-, B+, etc.)

**HBY 570: Student Journal Club**
Graduate student presentation on a selected topic with faculty consultation.
1 credit, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

**HBY 590: Special Topics in Physiology and Biophysics**
Students seminars on topics to be arranged through consultation with faculty members.
Prerequisite: Permission of instructor.
Offered
Fall and Spring, 1 credit, S/U grading
May be repeated for credit.

**HBY 591: Physiology and Biophysics Research**
Original investigation under the supervision of a staff member.
1-12 credits, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

**HBY 690: Seminar in Physiology and Biophysics**
Seminars and discussions on major topics in physiology and biophysics by students, staff, and visiting scientists. Prerequisite: Permission of instructor
0-1 credits, S/U grading
May be repeated for credit.

**HBY 695: Practicum in Teaching in Physiology and Biophysics**
Practical experience and instruction in the teaching of physiology and biophysics carried out under faculty orientation and supervision.
1 credit, Letter graded (A, A-, B+, etc.)
May be repeated for credit.

**HBY 699: Dissertation Research on Campus**
Original (thesis) research undertaken with the supervision of a member of the staff.
Prerequisite: Advancement to candidacy (G5); permission of thesis advisor. Major portion of research must take place on SBU campus, at Cold Spring Harbor, or at the Brookhaven National Lab.
1-9 credits, S/U grading
May be repeated for credit.

**HBY 700: Dissertation Research off Campus - Domestic**
Prerequisite: Must be advanced to candidacy (G5). Major portion of research will take place off-campus, but in the United States and/or U.S. provinces. Please note, Brookhaven National Labs and the Cold Spring Harbor Lab are considered on-campus. All international students must enroll in one of the graduate student insurance plans and should be advised by an International Advisor.
1-9 credits, S/U grading
May be repeated for credit.

**HBY 701: Dissertation Research off Campus - International**
Prerequisite: Must be advanced to candidacy (G5). Major portion of research will take place outside of the United States and/or U.S. provinces. Domestic students have the option of the health plan and may also enroll in MEDEX. International students who are in their home country are not covered by mandatory health plan and must contact the Insurance Office for the insurance charge to be removed.
1-9 credits, S/U grading
May be repeated for credit.

**HBY 800: Full-Time Summer Research**
Full-time laboratory research projects supervised by staff members.
S/U grading
May be repeated for credit.

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**HCB Medical Humanities, Compassionate Care & Bioethics**

Stony Brook University Graduate Bulletin: www.stonybrook.edu/gradbulletin
HCB 501: Compassionate Care, Medical Humanities, and the Illness Experience
This course will introduce students to major interpretations of the illness experience, to several classical biographical and autobiographical accounts of illness, and to the important dynamic of compassionate care in the healing relationship. The patient-as-person will be emphasized throughout, as well as the ways in which respect for and empathy toward the patient impacts diagnostic accuracy, patient adherence, and patient and professional satisfaction. Some emotional dynamics of the illness experience will be addressed, such as hope, through the work of eminent physician-writers such as Jerome Groopman, MD. The dynamics of medical mistakes and forgiveness will be explored through psychiatrist Aaron Lazarre's influential writings on effective medical apologies. Some philosophical and metaphysical aspects of personhood and self-identity will be introduced.

Offered in Fall, 3 credits, Letter graded (A, A-, B+, etc.)

HCB 502: Landmark Cases in Bioethics
What is a life worth living? How do we decide, and who decides, when to use medical technologies such as incubators, ventilators, transplants and reproductive technologies? This is an intensive introduction to some of the cases in medical ethics that have changed the ways that we are born, cared for, and die in American hospitals. Examples of topics include: vaccination and public health; eugenics and human subjects research ethics; the right of privacy and health care; end-of-life planning and treatment; women's bodies and fetal rights; disability rights; mental illness and individual rights; global clinical trials; and, bioethics and culture.

Offered in Fall, 3 credits, Letter graded (A, A-, B+, etc.)

HCB 503: Traditions and Values in Bioethical Conflicts
This course serves as an introduction to Western moral and religious traditions and to the positions about killing, saving, and enhancing that these traditions have informed. It explores the interface between religious and biomedical ethics and then delves into specific issues in health care in light of more general normative concerns such as justice, love, autonomy and rights, utilitarianism, self-sacrifice, gender, virtue, and community. The issues with which the course deals address the plights of real people, in the concrete, who come from particular backgrounds and whose set of values may make them sometimes recalcitrant to possibilities that technology has made (or is just now making) available.

Offered
Fall, 3 credits, Letter graded (A, A-, B+, etc.)

HCB 504: Special Topic in Biotechnology
Just because we can do it, does this mean that we should do it? This course takes a focused look at controversial practices in health care settings, such as organ donation and enhancements, which have been (and are continuing to be) made available with the advancement of technology. Ought we to regard that which technology makes available as uncontroversial good? If not, why not? What sorts of new issues regarding distributive justice, autonomy, utility, and compassion are ours to consider carefully because of the changing world in which we live?

Offered in Spring, 3 credits, Letter graded (A, A-, B+, etc.)

HCB 510: Literature, Compassion, and Medical Care
How does literature help us understand the nature of human illness and suffering? Can written works of art, ancient and contemporary, that depict moments of compassion and compassionate acts lay bare the moral, spiritual, psychological, and physical reality of suffering? There is a long association between literature and medicine, from the viewpoint of physician-writers, such as Anton Checkov and William Carlos Williams, whose literary skills have eclipsed their medical backgrounds. Sherlock Holmes and Doctor Watson were the creations of a physician-writer, Arthur Conan Doyle. Physicians portrayed in literature, such as Dr. Bernard Rieux, in Albert Camus The Plague, have also explored the relationship between patient and doctor, the nature of healing.

This semester-long course will study these relationships through reading of poetry, drama, fiction, memoir, and essay and reflect on the nature of suffering, the intrinsic human need for compassion, and the implications for health and healing.

Offered in Fall, 3 credits, Letter graded (A, A-, B+, etc.)

HCB 512: Altruism and Bioethics
What is altruism, and what is its evolutionary roots as a moral dynamic? What impact does altruistic action have on the human agent? Does it impact flourishing and health? When is it experienced as overwhelming by medical professionals? Where does altruism fit within medical and nursing professionalism? How is it related to compassionate care? What about the duty to treat in time of epidemic, auto-experimentation, pro-bono medical treatment, high-risk provision of healthcare in time of conflict, healthcare activism, and the commitment to the patient's good as a guiding professional ideal? How does the practitioner strike a balance between the care of patients and the care of the nearest and dearest or the care of the self? How does altruism correlate with pro-social behavior, happiness, and health?

Offered in Fall, 3 credits, Letter graded (A, A-, B+, etc.)

HCB 513: Disease and Society
What is disease? How do the beliefs, politics, and economies of particular societies shape how diseases are defined, experienced, and treated? In this seminar, students will explore these questions by analyzing historical documents, scientific reports, and historical scholarship. We will look at disease from multiple perspectives as a biological process, clinical entity, population phenomenon, historical actor, and personal experience. We will pay special attention to how diseases have been recognized, diagnosed, named, classified and counted in different times, places, cultures, and settings based on different environmental and social conditions, medical ideas, diagnostic technologies, and available...
treatments. The course will begin with a review of major approaches to understanding the manifold relationships between disease and society. The remainder of the course will view disease and society relationships through the lens of specific issues, such as epidemic disease, consumption and affluence, globalization, and risk. 

Offered in Fall, 3 credits, Letter graded (A, A-, B+, etc.)

HCB 514: Global Bioethics
Bioethics is an American invention. Ideas about medicine and morality, of course, go back to antiquity and are documented as medical ethics in Europe, medical morality in China, and under many other names in cultures around the world. Recently, the process of globalization of ideas, medical practices, clinical trials, and migration of patients has led to clashes of culture around issues such as the appropriate standards and control groups for clinical trials, organ transplantation, brain death, and end-of-life care. Issues of religion, morality, public policy, disability rights and policy, and health system structure and payment all shape how particular societies decide to manage divisive issues such as the beginning and end of life. This course will draw on a growing literature on global and transnational cases, policies, and traditions in the ethics of health, public health, and health care.

Offered in Spring, 3 credits, Letter graded (A, A-, B+, etc.)

HCB 515: Health Policy, History & Ethics
Who gets sick? Who gets health care, what kind, and in what setting? This course covers the major health policy issues of the United States today, including the health status of the U.S. as a whole, the social and economic determinants of health, the role of personal and public health services in affecting health, the organization and financing of health services, and the multiple factors affecting health policies. We will explore the evolution of the US health care system in the past century, and debates about rights to health care or lack thereof, health disparities, conflicts of interest, and the ethics of health policy and practice.

Offered in Fall, 3 credits, Letter graded (A, A-, B+, etc.)

HCB 516: Ethical Issues in Human Reproduction
New technologies have modified human reproduction in numerous ways, raising profound questions about the moral status of human life and the nature of parental and sibling obligations. This course will investigate the values that attach to different relationships, both familial and general. It will cover questions around the treatment of infertility, surrogate mothering, the commodification of the body, and the elevated expectations of familial obligations that correspond to new reproductive technologies.

Offered in Spring, 3 credits, Letter graded (A, A-, B+, etc.)

HCB 517: The Problem of Evil: Philosophical, Biological, and Social Dimensions
What is the nature of evil? Can it be the result of brain malfunction, something that is genetically predetermined? Or, is evil something which is part of or at least necessary to know the good? Alternatively, is evil an arbitrary designation, a perspective from which we can wrest ourselves given the right sort of reinvention? In this class, we shall address the problem of evil from scientific, social-scientific, and philosophical perspectives, using fiction and non-fictional sources. Examples of medical evil, such as the Nazi doctors or Tuskegee, can be introduced as case studies.

Offered in Spring, 3 credits, Letter graded (A, A-, B+, etc.)

HCB 518: Empirical Bioethics
The formal study of bioethics attempts to define ethical courses of action in a world ever increasing in complexity. But in day to day practice, ethical outcomes are expressed through the individual decisions and resulting actions--of human agents. How do individuals form these judgments? How do people become motivated to engage in behaviors that are designed to benefit someone else? We will explore current scientific approaches to these questions with several areas of emphasis, including a) the neuroscience of compassionate care and altruism, b) cognitive and neuroscientific approaches to understanding judgment and decision making in ethical domains, and c) empirical approaches to quantifying the effects of ethically based policy decisions.

Offered in Spring, 3 credits, Letter graded (A, A-, B+, etc.)

HCB 519: Public Health Law
This course is a survey of legal and policy issues that have special relevance for public health professionals. Topics may vary, but typically will include many of the following: structure of the U.S. legal system; power of state and federal governments in matters affecting health care; governmental power and the right to privacy; constitutional issues in social welfare benefits; governmental regulation of health care providers and payers; the scope and discretion of administrative agencies in health care; the antitrust laws; the fraud and abuse laws; and negligence in the delivery and financing of health care. The course is taught primarily by Socratic method.

Offered in Spring, 3 credits, Letter graded (A, A-, B+, etc.)

HCB 520: Bioethics and Film
Film and television, both fiction and nonfiction, capture man of the human tragedies, challenges, and possibilities that are debated in bioethics books, articles, newspapers, on hospital ethics committees, and in daily clinical care. This course will explore themes of birth, death, hope, fear, faith, finitude and resource allocation through watching, analyzing, and reading about bioethics issues in visual media. The course will draw on material from philosophical ethics to history, health policy, and film criticism to place these issues and their portrayals in context.

3 credits, Letter graded (A, A-, B+, etc.)

HCB 521: Clinical Ethics Practicum
As difficult as settling abstract ethical issues in medicine may be, the delivery of ethical care presents its own set of difficulties. This course aims to introduce students to the practices hospitals employ to ensure the care they deliver meets the relevant legal and moral requirements. At the end of this course, students will have been exposed to many basic, and some advanced, aspects of clinical ethics theory and practice. They will be able to identify, describe, and analyze ethical dilemmas in clinical cases, and will develop an appreciation for the complexity and multidisciplinary nature of ethical dilemmas in clinical medicine and will be able to apply what they have learned to assess ethical, social, and legal aspects of cases.

3 credits, Letter graded (A, A-, B+, etc.)

HCB 522: The Role of Virtue Ethics in Medicine
Aristotle's Nicomachean Ethics and the role of virtue ethics are central to many religious traditions including Buddhism, Christianity, Confucianism, and the philosophical traditions. Key virtues include honesty, courage, generosity, prudence, justice, compassion, benevolence, loyalty, and hospitality. This course explores the real and potential role of virtue on the development of virtuous physicians. The course's texts offer two diametrically opposed views on the role of virtue in medicine, i.e., one is that virtue can be channeled into the training of medical professionals, whereas the other is that
bioethics has extracted virtue from medicine. Through readings, documentaries, dialogue and active leadership of sessions by students, the course will interrogate the claims as well as possibilities for a role of virtue in medicine.

3 credits, Letter graded (A, A-, B+, etc.)

HCB 523: Special Topics in Medical Humanities
As with all multidisciplinary pursuits, the medical humanities project is characterized by an ongoing negotiation among its practitioners over methods, scope and goals. This course will examine, in detail, one of the latest debates within the field.

3 credits, Letter graded (A, A-, B+, etc.)
May be repeated 2 times FOR credit.

HCB 524: Special Topics in Bioethics
Bioethicists are frequently asked to consider the ethical ramifications of new research findings and emerging technologies as they arise. This course will examine one such issue in close detail.

3 credits, Letter graded (A, A-, B+, etc.)
May be repeated 3 times FOR credit.

HCB 597: Independent Study (Permission Only)
May be repeated 4 times FOR credit.

HCB 598: Independent Study
3 Credits, ABCF Grading
0-4 credits, Letter graded (A, A-, B+, etc.)
May be repeated 2 times FOR credit.

HCB 599: Special Projects Capstone Course
This course, to be offered in the second (spring) semester, is designed to satisfy the special projects requirement of our program.

The first part of the course will be devoted to readings and discussions that further illuminate the methodologies of the interdisciplinary field of medical humanities, compassionate care, and bioethics. Students will develop an appreciation for the standards of high quality scholarship and research through review of carefully selected readings. This will prepare them for the second part of the course, where they pursue and present their own research based on the existing literature. This capstone course will be highly collaborative, entail substantial peer review, and be organized around the development of significant student projects which are intended to represent the beginnings of publishable papers. Our entire faculty will be involved in these projects according to their specific areas of expertise.

Offered in Spring, 3 credits, Letter graded (A, A-, B+, etc.)

HDO 500: Biology of the Oral Mineralized Tissues
This course deals with the basic chemistry, crystallography, ultrastructure, and metabolism of the calcium phosphates involved in the formation and physiological and pathological resorption of the various mineralized tissues found in or associated with the oral cavity (enamel, dentin, cementum, bone). Ectopic calculus formation will be examined. Prerequisites: HDO 560, 561, 562, and 563 or their equivalent. Fall and Spring

3 credits, Letter graded (A, A-, B+, etc.)

HDO 510: Salivary Metabolism and Secretion
Consideration is given to the normal and abnormal structure and function of the glandular systems found in the oral cavity. The composition, regulation, and functions of the secretions from the major and minor salivary glands will receive particular attention.

3 credits, Letter graded (A, A-, B+, etc.)

HDO 520: Oral Microbial Systems
Consideration is given to the structural composition, metabolism, and environmental relationships of the bacterial systems formed on and in association with the oral hard and soft tissues. Specific and mixed bacterial populations, such as those resident on extra-oral mucosal surfaces and the skin and their role in oral disease will be dealt with. Prerequisite: HDO 560, 561, 562, and 563 or their equivalent. Fall and Spring

3 credits, Letter graded (A, A-, B+, etc.)

HDO 530: Molecular Biology and Pathology of the Periodontium
This course deals with the ultrastructure and biochemical composition of the periodontal tissues, remodeling of the extracellular matrix with an emphasis on the role of metalloproteinases; the microbial interrelations with the organic and inorganic components of the periodontal tissues, the biochemical dynamics of gingival inflammation and wound healing, and the metabolic processes responsible for the composition and flow of gingival crevicular fluid. Prerequisites: HDO 560, 561 and 563 or their equivalent. Fall and Spring. Please note that this may be taken twice for a total of 4 credits.

2 credits, Letter graded (A, A-, B+, etc.)
May be repeated 2 times FOR credit.

HDO 531: Normal and Reparative Tissue Development in the Oral Cavity
This course includes a series of lectures and student-led discussions dealing with specific oral tissues, biologic mineralization, osseointegration, hard and soft tissue development, and tissue regeneration. The molecular aspects leading to oral cancer and osteonecrosis will also be presented and discussed.

2 credits, Letter graded (A, A-, B+, etc.)

HDO 532: Host-Parasite Interaction
This course includes a series of lectures and student-led discussions dealing with specific oral tissues, growth factors, cytokines, prostaglandins, biologic mineralization and wound healing. The biology of the immune system and phagocytic cells is presented, including the relationship of nutrition to inflammation and oral health. The microbiology of the oral cavity in health and disease as well as oral mucosal infections is presented as the basis of the understanding of immunopathobiology of dental caries and periodontal disease. The oral manifestations of pharmacologic agents are reviewed in terms of both their immunologic and non-immunologic mechanisms of pathology. Finally, antimicrobial chemotherapy and principles of infection control are reviewed in terms of clinical practice of dentistry.

2 credits, Letter graded (A, A-, B+, etc.)

HDO 533: Regional Anatomy, Orofacial Neuroscience and Pain Control
This course includes a series of lectures and discussions dealing with head and neck gross anatomy and microanatomy and biochemistry of orofacial pain. It will provide an in-depth understanding of the underlying neuroanatomy and biochemical events leading to the perception of acute and chronic orofacial pain.

2 credits, Letter graded (A, A-, B+, etc.)

HDO 535: Epithelial Keratinization and Differentiation
The course examines the growth and differentiation of stratified squamous epithelia. Particular emphasis is placed on molecular events involved in the differentiation program. Consideration is also given to mechanisms involved in oral and cutaneous disorders. Prerequisites: Permission of instructor required; HBP 531 suggested; students must have had a background in cellular biochemistry and molecular biology.

Fall and Spring, 2 credits, Letter graded (A, A-, B+, etc.)

Stony Brook University Graduate Bulletin: www.stonybrook.edu/gradbulletin
HDO 541: Principles of Mucosal Immunology
The mucosal immune system is essentially the primary site of interaction between invading pathogens and the immune system. The overall aim of this graduate course is to facilitate a deeper understanding of the fundamentals of the immune system at mucosal surfaces. It will provide a broad overview of several core mucosal immunology topics and has been designed for graduate students and post-docs who have recently entered the field. This class will provide in-depth analysis of the structural features that distinguish the mucosal immune system from the peripheral immune system. Features of innate and adaptive immunity as they relate to mucosal immune responses will also be covered. As well as delivering in-depth lectures on relevant and emerging topics the course will engage participants in interactive discussions on topics in an informal setting. The course content is based on the "Principles of Mucosal Immunology" textbook.  
*3 credits, Letter graded (A, A-, B+, etc.)

HDO 550: Oral Diagnostics and Therapeutic Technology, Lectures and Laboratory Techniques
Recent advances in the use and development of research technology for the early diagnosis and treatment monitoring of oral and systemic disease. Special attention is paid to the principles of technology transfer including patents and patenting; searching of on-line databases is a key component. The course includes relationships of dry mouth to salivary physiology, diabetes, and drug medications; salivary film measurements, wetting of oral surfaces, viscoelasticity and lubricity; the use of the Periotron and enzyme assays for the diagnosis of gingivitis and periodontal disease; instrumentation used in sensitive teeth measurement and evaluation of treatment effectiveness using oral compositions and iontophoresis; oral candidiasis and denture stomatitis and early detection and causes of dental caries; oral malodor measurements including use of the Halimeter and its use in the formulation of oral compositions. Application to clinical practice and clinical studies is covered.  
*3 credits, Letter graded (A, A-, B+, etc.)

HDO 560: Oral Biology and Pathology I
The first of four comprehensive courses on molecular structure, biochemical and physiological function, developmental anatomy and pathology of the various systems that constitute the oral apparatus. Covers the embryological development of the face and oral cavity and the biology and pathology of the oral mineralized tissues. Prerequisites: Undergraduate degree in basic science; permission of instructor. Fall and Spring  
*3 credits, Letter graded (A, A-, B+, etc.)

HDO 561: Oral Biology and Pathology II
The second of four comprehensive courses on molecular structure, biochemical and physiological function, developmental anatomy and pathology of the various systems that constitute the oral apparatus. Covers the biology and pathology of the periodontal structures and the microbiology of the oral cavity. Prerequisites: Undergraduate degree in basic science; permission of instructor. Fall and Spring  
*3 credits, Letter graded (A, A-, B+, etc.)

HDO 562: Oral Biology and Pathology III
This course is the third of four comprehensive courses on molecular structure, biochemical and physiological function, developmental anatomy, and pathology of the various systems that constitute the oral apparatus. The course consists of the following two units of instruction: (1) the biology and pathology of the salivary glands and their products and (2) the biology and pathology of the periodontal structures. Prerequisites: Undergraduate degree in basic science and permission of instructor. Fall and Spring  
*3 credits, Letter graded (A, A-, B+, etc.)

HDO 563: Oral Biology and Pathology IV
This course is the last of four comprehensive courses on molecular structure, biochemical and physiological function, developmental anatomy and pathology of the various systems that constitute the oral apparatus. Covers the biology and pathology of the oral sensory systems and the biology and pathology of oral motor systems. Prerequisites: Undergraduate degree in basic science and permission of instructor. Admission to Graduate Health Sciences Center Program.  
*3 credits, Letter graded (A, A-, B+, etc.)

HDO 569: Graduate Research
Original investigations undertaken with supervision of a faculty member.  
*1-12 credits, Letter graded (A, A-, B+, etc.)

May be repeated for credit.