ESG 310 Research Methods for Engineers and Scientists
Introduction to the scientific method and research methods within the context of engineering and the sciences. Topics include: interpretation of research, design of experiments, ethics, writing an abstract, use and abuse of statistics in reporting data, presentation and publication. Pre- or Corequisite: A research, independent study, or internship course
3 credits

ESG 312 Engineering Laboratory
Laboratory exercises and lectures covering the theory, practice, and design of engineering experimentation. The course has three components: error analysis and data message; electrical circuits and experiment control; and mechanical and optical measurement. Laboratory fee required.
Prerequisites: PHY 126 and 127 or PHY 132/134; U3 standing
Pre- or Corequisite: ESG 332
3 credits

ESG 316 Engineering Science Design II: Methods
Design and design-planning methods are developed from the conceptual stages through the application stages using lecture and laboratory. Includes synthesis, optimization, modeling, and simulation and systems engineering. Case studies illustrate the design process.
Laboratory fee required.
Prerequisites: ESG major; U2 standing or higher; ESG 217; AMS 161 or MAT 127 or MAT 132 or MAT 142
Corequisite: ESG 300
3 credits

ESG 320 Sensor Materials and Devices
Presents sensors as the physical, chemical, and biological detectors necessary for monitoring human health, the environment, and industrial processes. Covers the basic principles of operation, materials selection, and fabrication using nanomaterials.
Prerequisites: CHE 198, ESG 281, and AMS 361
3 credits

ESG 332 Materials Science I: Structure and Properties of Materials
A study of the relationship between the structure and properties of engineering materials and the principles by which materials’ properties are controlled. The structure and the natural imperfections of simple crystalline materials and the role that these factors play in defining electrical conductivity, chemical reactivity, strength, and ductility are considered. The molecular structure of polymers is discussed and related to the behavior of plastics, rubbers, and synthetic fibers. The principles of phase equilibria and phase transformation in multicomponent systems are developed. These principles are applied to the control of the properties of semiconductors, commercial plastics, and engineering alloys by thermochemical treatment. Corrosion, oxidation, and other deterioration processes are interpreted through the interaction of materials with their environment.
Prerequisite: CHE 131 or 141 or 198
3 credits

ESG 333 Materials Science II: Electronic Properties
After a review of quantum mechanics and atomic physics, the binding energy and electronic energy levels in molecules and solids are discussed. The free-electron theory of metals is introduced and applied to the quantitative treatment of a number of electron emission effects. The band theory of solids is developed quantitatively via the Kronig-Penney model, and the transport properties of metals and semiconductors are discussed in detail. The physical principle of pn junctions, transistors, tunnel diodes, etc. is explained. Fundamentals and applications of photoconductors, lasers, magnetic materials, and superconductors are also discussed. (ESG 332 is not a prerequisite.)
Prerequisite: ESG 281 or PHY 251
3 credits

ESG 339 Thin Film Processing of Advanced Materials
Fundamental aspects of thin film materials design, fabrication, and characterization. Overviews of semiconductor fabrication, surface analysis, and vacuum system design. This course includes a design content of one credit, achieved through a design exercise related to thin film fabrication.
Prerequisite: ESG 332, or ESE 331 for ESE majors
3 credits

ESG 440 Engineering Science Design III
Lectures by faculty members and visitors on typical design problems encountered in engineering practice. During this semester each student chooses a senior design project. A preliminary design report is required. Not counted as a technical elective. Laboratory fee required.
Prerequisites: ESG 416; ESG major; U4 standing
Pre- or Corequisite: ESG 441
3 credits

ESG 441 Engineering Science Design IV
Student groups carry out the detailed design of the senior projects chosen during the first semester. A final and detailed design report is prepared. Not counted as a technical elective. Laboratory fee required.
Prerequisite: ESG 440
3 credits

ESG 487 Cooperative Research in Technological Solutions
An independent research course in which students apply principles of engineering design, technological problem solving, mathematical analysis, computer-aided engineering, and effective teamwork and communication to develop solutions for a need in a governmental, educational, non-profit, or community organization in a multidisciplinary setting.
Prerequisites: U3 or U4 standing; an abstract of the project; permission of instructor
0-3 credits

ESL English as Second Language

ESL 191 Intermediate Oral/Aural Skills
Students improve skills necessary for speaking and understanding English. Special emphasis on developing communication capabilities. Class work includes pronunciation, vocabulary development, guided conversation, and listening practice. Language and listening laboratories required. Diagnostic test during first week of classes determines placement in the course.
3 credits

ESL 192 Intermediate Composition
A course for students who have attained a degree of fluency in speaking English but need additional training in reading and writing skills. Beginning with basic sentence patterns and working toward paragraph development and, eventually, longer themes, each student has the opportunity to practice many different varieties of writing. May be repeated but counts only once toward graduation. Diagnostic test during first week of classes determines placement in the course. A through C/Unsatisfactory grading only. The Pass/No Credit option may not be used.
Prerequisite: Level 1 on the writing placement examination
3 credits, ABC/U grading

ESL 193 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. The Pass/No Credit option may not be used.
Prerequisite: Level 2 on the writing placement examination
3 credits, ABC/U grading

ESL 194 Academic English Skills for U.S. Residents
The study of spoken and written English for students who are graduates of American high schools but are non-native speakers of English. The focus of the course is on helping students to speak, write, and understand English in academic contexts. Particular attention is paid to understanding lectures, increasing vocabulary, and improving knowledge of English sentence structure. Open to first semester English enrichment program students only. The Pass/No Credit option may not be used. Only for students in the English Enrichment Program.
3 credits

ESL 198 Advanced Oral/Aural Skills and Accent Improvement
An advanced course in speaking and listening skills for non-native speakers of English. Work is done with individual problem sounds, stress, and intonation to help students modify their accents and make their speech more intelligible. Techniques of speaking before a group are taught to enable non-native speakers to feel more confident in participating in their other classes. Advanced work in American idioms and grammar is usually included. Language laboratory work may be required by individual instructors. Especially useful for undergraduate and graduate students who need to make seminar presentations and for graduate students with teaching assistantships.
Prerequisite: Completion of ESL 191 with a grade of B or TSE or SPEAK score of 50 or higher.
3 credits

ESL 475 Undergraduate Teaching Practicum I
Students have the opportunity to apply the methodology learned in LIN 375 in small tutorial sections under the direction of a master teacher. They work with students in the oral/aural skills ESL courses, emphasizing communicative competency. There is a seminar component to the course, meeting weekly.
Prerequisites: LIN 375; permission of instructor.
3 credits, S/U grading

ESL 476 Undergraduate Teaching Practicum II
Students have the opportunity to apply the methodology learned in LIN 375 in small tutorial sections under the direction of a master teacher. They work with students in the reading/composition skills ESL courses, emphasizing preparation for university writing.
Prerequisites: ESL 475; permission of instructor
3 credits, S/U grading

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