

MEC 422 (SBU) Fall 2023

Thermal System Design

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Class Time and Location: TuTh: 4:00 PM – 5:20 PM JAVITS LECTR 111
WESTCAMPUS

Instructor: Professor Foluso Ladeinde

Office Location: Heavy Engineering 224

Preferred E-mail Address: foluso.ladeinde@stonybrook.edu

Instructor Office Hours (Tentative): Tuesdays, 10:00 AM – 12:00 Noon, 1:00 – 2:00 PM

TA: Taiwo Alare, Abdullah Sharfuddin **TA Hours:** TBD

Pre-requisites: MEC 305.

Number of Credits: 3

Textbook: Design of Fluid Thermal Systems by William S. Janna, Cengage Learning, Fourth Edition, 2015, ISBN-13:978-1-285-85965-1, ISBN-10:1-285-85965-0.

Course Description: Device design and system design. Quantitative data for system design including operating characteristics of compressors, turbines, heat exchangers, piping systems, internal combustion engines, and other component equipment. Component matching and system simulation. Optimization including thermo-economic evaluation and energy analysis. Case studies: refrigeration and air conditioning systems; combined cycles; Gas turbines.

Tentative Course Flow (Subject to Change)

(This is shown in the table below. All dates are of course approximate.)

WEEK	TOPIC	DATES
Week 1.	Introduction, Basic Equations	8/28-9/1
Week 2.	Basic Equations	9/4-9/8
Week 3.	Piping System I	9/11-9/15
Week 4.	Piping System II	9/18-9/22
Week 5	Flow Measurement and Piping Networks	9/25-9/29
Week 6	(Midterm I: 10/03/2023; Tuesday)	10/03
Week 6.	Economic Pipe Design, Optimization	10/05
Week 7:	Fall Semester Break	10/9 (Mon.), 10/10 (Tues.)
Week 7, 8, 9	Constrained and Unconstrained Optimization; Lagrange Multipliers, Search Methods, Linear Programming	10/12, 10/17, 10/19, 10/24
Week 9, 10	Double Pipe Heat Exchangers, Shell and Tubes Heat Exchangers	10/26, 10/31
Week 10.	(Midterm II: 11/2/2023; Thursday)	11/2
Week 11,12	Plate-Fin/Plate-Frame/Cross Flow HXs	11/6 - 11/10, 11/14-11/18
Week 13.	Thermal Management of Automotive, Aircraft, and Rocket Combustors	11/21
Week 13	Thanksgiving Break – No Classes	11/22-11/26 (Wednesday – Sunday)
Week 14	Thermal Management of Automotive, Aircraft, and Rocket Combustors	11/28
Week 14,15.	Thermal System Simulation: Examples from Refrigeration and Air-conditioning Systems, Power Plants	11/30, 12/5-12/7
	Last Day of Class at SBU	12/11
	FINALS Week at SBU	12/11 – 12/21
	Final Exam in Course	TBD
	Semester End: Official End of Term	12/21 (Thursday)
	Commencement	12/16 (Friday)

Class Delivery Details

Class Delivery Mode: In-Person

Homework assignments will be posted on Brightspace or sent to you by email. You should submit your solutions electronically via Brightspace. All exams will take place in-person, in either structured or Take-Home format. Details will be provided to you in due course of time.

Copyright Statement: Lecture notes, video recordings, examinations, homework problems and their solutions, and other materials shared with you in the course of lecture delivery – be it in-person or online - constitute intellectual properties (IPs). Therefore, sharing these materials in any shape or form without a signed, written permission from me (Professor Foluso Ladeinde) constitute infringement for which a legal recourse is available in the court of law. This option will be exercised in the event of an IP infringement.

Course Rules:

- You will need to learn to use Brightspace and Zoom. Please visit SBU's DoIT to do this: <https://sites.google.com/stonybrook.edu/keeplearning>
- Please keep abreast of class announcements, which would come from emails and/or Brightspace.
- Office Hours is primarily via Zoom at the link below. However, you are more than welcome to schedule in-person meetings with me during office hours.

Join Zoom Meeting

<https://stonybrook.zoom.us/j/98428611701?pwd=WHc4SWF3RldmbUJkQjMyL2l1bEdjUT09>

Meeting ID: 984 2861 1701

Passcode: 221111

Homework:

Approximately two homework sets in three weeks.
Homework will be due one week after it has been assigned.
Late homework will receive half credit before the solutions are posted and will not be accepted after that.

Exams:

All exams will be scheduled as described above
No makeup exam unless arranged prior to the exam.

Grading Scale:

Will grade on a curve in this course.

Grading Scheme (Subject to Change):

Midterm I: 20%
Midterm II: 20%
Final (Cumulative): 30%
Design Project: 15%
Homework Assignments: 10%
Attendance: 5%

Homework and exams are to be done individually. Homework must be neat and orderly so that your work can be followed clearly. Solutions which are not clearly written and easy to follow (based on the judgment of the instructor) will not be graded.

ABET Student Outcomes (SOs) Supported by Course:

SO 2: Design (2)

SO 3: Communication (1)

SO 7: New knowledge (2)

Student Accessibility Support Center Statement:

If you have a physical, psychological, medical or learning disability that may impact your course work, please contact Student Accessibility Support Center, ECC (Educational Communications Center) Building, Room 128, (631)632-6748. They will determine with you what accommodations, if any, are necessary and appropriate. All information and documentation is confidential.

Students who require assistance during emergency evacuation are encouraged to discuss their needs with their professors and Student Accessibility Support Center. For procedures and information go to the following website: <http://www.stonybrook.edu/ehs/fire/disabilities>

Academic Integrity Statement:

Each student must pursue his or her academic goals honestly and be personally accountable for all submitted work. Representing another person's work as your own is always wrong. Faculty is required to report any suspected instances of academic dishonesty to the Academic Judiciary. Faculty in the Health Sciences Center (School of Health Technology & Management, Nursing, Social Welfare, Dental Medicine) and School of Medicine are required to follow their school-specific procedures. For more comprehensive information on academic integrity, including categories of academic dishonesty please refer to the academic judiciary website at http://www.stonybrook.edu/commcms/academic_integrity/index.html

Critical Incident Management:

Stony Brook University expects students to respect the rights, privileges, and property of other people. Faculty are required to report to the Office of University Community Standards any disruptive behavior that interrupts their ability to teach, compromises the safety of the learning environment, or inhibits students' ability to learn. Faculty in the HSC Schools and the School of Medicine are required to follow their school-specific procedures. Further information about most academic matters can be found in the Undergraduate Bulletin, the Undergraduate Class Schedule, and the Faculty-Employee Handbook.

Allowed Calculators:

Following the Mechanical Engineering Department's mandatory calculator policy, only the following calculators will be allowed to be used on the midterm and final exams. There will be no exceptions. This list of calculators is identical to that allowed for the *National Council for Examiners for Engineering and Surveying* (NCEES) Fundamentals of Engineering (FE) exam that many of you will take in your senior year, as well as the Professional Engineering (PE) exam that you may take several years from now. The sooner you become comfortable on one of these calculators, the better. If you have any questions on this policy please feel free to contact me. The NCEES policy on calculators can be found here: <http://www.ncees.org/exams/calculators/> .

Casio: All **fx-115** models. Any Casio calculator must contain **fx-115** in its model name.

Hewlett Packard: The **HP 33s** and **HP 35s** models, but no others.

Texas Instruments: All **TI-30X** and **TI-36X** models. Any Texas Instruments calculator must contain either **TI-30X** or **TI-36X** in its model name.

MEC 422 Thermal System Design											
Credits: 3						Contact Hours: 3 hour lectures per week					
LEAD COORDINATOR				TEXTBOOK							
D. Hwang				Design of Fluid Thermal Systems by William S. Janna, Cengage Learning, Fourth Edition, 2015, ISBN-13:978-1-285-85965-1, ISBN-10:1-285-85965-0							
BULLETIN DESCRIPTION											
Device design and system design. Quantitative data for system design including operating characteristics of compressors, turbines, heat exchangers, piping systems, internal combustion engines, and other component equipment. Component matching and system simulation. Optimization including thermo-economic evaluation and energy analysis. Case studies: refrigeration and air conditioning systems; combined cycles; steam-injected gas turbines.											
PREREQUISITES: MEC 305						THIS COURSE IS Required					
STUDENT OUTCOME SUPPORTED				PIs				ASSESSMENT TOOLS			
2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.				2a. Identify need for the design, as well as multiple, realistic constraints on the design with consideration of public health, safety, welfare, and other societal factors.				Exams, Homework, Project			
				2b. Identify appropriate engineering standards for the design				Exams, Homework, Project			
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.				7a. Analyze the knowledge and skills needed at the beginning of a project.				Exams, Homework, Project			
				7b. Develop strategies to acquire the missing knowledge or skills.				Exams, Homework, Project			
				7c. Apply new knowledge as needed for a project				Exams, Homework, Project			
STUDENT OUTCOME SUPPORT	1	2	3	4	5	6	7				
		3					2				
	3 – Strongly supported 2 – Supported 1 – Minimally supported										
COURSE TOPICS	1. Introduction to design and analysis and project initiation 2. Fluid properties and basic equations 3. Piping systems I 4. Piping systems II 5. Selected topics in Fluid mechanics 6. Pumps and piping systems 7. Some heat transfer fundamentals 8. Double pipe heat exchangers 9. Shell and tube heat exchangers 10. Plate and frame and cross flow heat exchangers 11. Project										

Make-up classes:

In the event that, for any reasons, I am not able to attend one or more of our regularly scheduled classes, as is the case when I go to conferences or attend to urgent family issues, I will make all efforts to get a substitute who is competent in teaching this course. Otherwise, I will make up missed classes at a mutually convenient time. I will announce suggested make up times well in advance, and make sure that they are reasonable for everyone, at least as much as is feasible.