MEC 423/523: Internal Combustion Engines

Fall 2024

Course Description: Introduction to internal combustion engines and their operation. Analytical approach to the engineering problem and performance analysis of internal combustion engines. Topics include thermodynamics fundamentals; fuel-air cycle analysis; engine combustion; emission formation and control strategies. Includes both the relevant fundamental concepts and the extensive practical knowledge base on which engine research, development, and design depend.

Instructor: Assistant Professor Dimitris Assanis
Email: dimitris.assanis@stonybrook.edu, include [MEC 423/523] in subject line
Office: 131 Light Engineering

Lectures: Tu, Th 5.00 PM – 6.20 PM (Frey Hall 313)

Office Hours: Tu Th 3.00 PM – 4.30 PM (Prof. Assanis - Light Engineering 131)
or other in-person/zoom times by email appointment
Alternate times for when Prof. Assanis is unavailable:
Tu 1.00 - 2.30 PM (Ms. Sirna – 158 Light Eng. – TA LOUNGE)
W 4.00 - 5.30 PM (Ms. Sirna – 158 Light Eng. – TA LOUNGE)

Credit Hours: 3

Prerequisites: MEC 305

Recommended Text: John Heywood, *Internal Combustion Engine Fundamentals*, McGraw-Hill, 2E.
The textbook is strongly recommended for the class. Detailed notes are provided.

Attendance: Attendance to ALL lectures is mandatory. Randomly check - one unexcused absence allowable.

Homework: Seven homework sets. Required to be completed to receive a course grade.
Additionally, there will be a required laboratory project for MEC 523.

Exams: One take-home midterm exam (Tue, Oct 22nd, 2024). Required.
One final exam (Tue, Dec 12th, 2024 @ 5.30 - 8.00PM). Required.
No makeup exams, unless arranged prior to the exam.

Grading:

	MEC 423	MEC 523
Homework:	20%	10%
Attendance:	20%	20%
Project:	--	10%
Midterm:	25%	25%
Final:	35%	35%

Learning Objectives:

1. Engine Classification
2. Engine Design and Operating Parameters
3. Ideal Models of Engine Processes and Cycles
4. Combustion Thermodynamics
5. Thermodynamic Properties of Engine Working Fluids
6. Fuel/Air Cycle Analysis
7. Spark-Ignition Engine Combustion Basics
8. Diesel Engine Combustion Basics
9. SI and Diesel Engine Emissions

Teaching Assistant: Ms. Amanda Sirna (amanda.sirna@stonybrook.edu)

Brightspace: We are using Brightspace, a digital learning environment, for this course. To learn more and for SUNY Online help desk information, visit: https://brightspace.stonybrook.edu. If you would like, you can add a link to Brightspace in your Blackboard "My Courses" list to easily move between the LMS's during this transition. Information can be found : https://it.stonybrook.edu/help/kb/adding-brightspace-course-to-bb-course-list

Student Accessibility Support Services: If you have a physical, psychological, medical, or learning disability that may impact your course work, please contact the Student Accessibility Support Center, Stony Brook Union Suite 107, (631) 632-6748, or at sasc@stonybrook.edu. They will determine with you what accommodations 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 the Student Accessibility Support Center. For procedures and information go to the following website: https://ehs.stonybrook.edu//programs/fire-safety/emergency-evacuation/evacuation-guide-disabilities and search Fire Safety and Evacuation and Disabilities.

Academic Integrity: 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 Professions, 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 Student Conduct and 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.

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.

The NCEES policy on calculators can be found here: http://www.ncees.org/exams/calculators/

Schedule:

Date	Day	Lecture Chapter	Heywood Chapter	Topic	HW Assigned	HW Due
27-Aug	Tue	0		Chap. 0: Class Introduction, Syllabus		
29-Aug	Thu	0		Introductory Lab Tour @ ACES Laboratory (Room 118, AERTC)		
3-Sep	Tue			Introductory Lab Tour @ ACES Laboratory (Room 118, AERTC)		
5-Sep	Thu	0		Chapter 1: Applications; Basic Engine Design; Working Cycle;		
10-Sep	Tue	1		Chapter 1: Method Of Breathing, Valve and Port Design	HW #1	
12-Sep	Thu	1		Chapter 1: Fuels; Method of Mixture Prep, Ignition, and Comb; Method of Load Control		
17-Sep	Tue	2	2	Chapter 1: Impact of IC Engines on Society		
19-Sep	Thu	2	2	Chapter 2: Engine Geometry		HW #1
24-Sep	Tue	2	2	Chapter 2: Brake & Indicated Perf. Parameters,	HW# 2	
26-Sep	Thu	2	2	Chapter 2: Tuning & Performance Variable Relationships		
1-Oct	Tue	3	5	Chapter 3A: Ideal Models of Engine Processes and Cycles (closed cycle analysis)		
3-Oct	Thu	3		Chapter 3A: Ideal Models of Engine Processes and Cycles (closed cycle analysis)		HW #2
8-Oct	Tue	3	5	Chapter 3B: Ideal Models of Engine Processes and Cycles (open cycle analysis)	HW #3	
10-Oct	Thu	3	5	Chapter 3B: Ideal Models of Engine Processes and Cycles (open cycle analysis)		
15-Oct	Tue	3	5	**(No Class - Fall Study Break)**		
17-Oct	Thu	3	5	Chapter 4A: Combustion Thermodynamics - Air & Fuels, Comb. Stoichiometry, Dissociation		HW #3
22-Oct	Tue	4	3	**(No Class / Take-home Midterm Exam -- ASME Internal Combustion Engines Fall Conference)**		
24-Oct	Thu	4	3	Chapter 4A: Combustion Thermodynamics - Equilibirum Combustion Products, Practical Chemical Equilibrium		
29-Oct	Tue	4	3	Chapter 4B: Combustion Thermodynamics - 1st Law Analysis of Closed Reacting Systems, Enthalphy of Formation, Heating Value	HW #4	
31-Oct	Thu	4	3	Chapter 4B: Combustion Thermodynamics		
5-Nov	Tue	4	3	Chapter 5: Thermodynamic Properties of Engine Working Fluids,	Project Assigned	HW #4
7-Nov	Thu	4&5	3 & 4	Chapter 6: Fuel-Air Cycle Ananlysis, Results, Efficiency & Performance, Computer Cycle Simulation, Comparison of Sim. & Actual Cycles, - (LAB TOUR/ENGINE EXPERIMENT 6:30-8PM @ AERTC)	HW #5	
12-Nov	Tue	5&6	3 &4	Chapter 7: SI Combustion - Features of the Combustion Process, Flame Structure & Turbulent Flame Propagation - (LAB TOUR/ENGINE EXPERIMENT 6:30-8PM @ AERTC)		
14-Nov	Thu	5&6	3 &4	Chapter 7: SI Combustion - Lean Burn Engine Example, Flame Termination, MFB, Spark Timing, Combustion Abnormalities	HW #6	HW #5
19-Nov	Tue			Chapter 8: CI Combustion - Diff from SI Engines, CI Engine Systems, Features of CI Combustion Process		
21-Nov	Thu			Chapter 8: CI Combustion - Ignition Dealy and Heat Release, Knock		
26-Nov	Tue			Advanced Combustion Modes	HW #7	HW #6
28-Nov	Thu	8	10	**(No Class - Thanksgiving Break)**		
3-Dec	Tue	8	10	Chapter 9: Emissions Regulations, Gasoline Engine Aftertreatement, Diesel Engine Aftertreatement		
5-Dec	Thu	8	10	FUTURE PERSPECTIVE OF ICE ENGINE		HW #7
10-Dec	Tue	8	10	Final Exam Review		Project Due
12-Dec	Thu	9	11	Final Exam 5:30-8:00PM		