MEC 423/523: Internal Combustion Engines

Fall 2022

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: M, W 4.25 PM – 5.45 PM (Melville Library W4540)

Office Hours: M 6.00 PM – 8.00 PM (Light Engineering 131)
W 11.00 AM – 1.00 PM (Light Engineering 131)

Credit Hours: 3

Prerequisites: MEC 305

Recommended Text: John Heywood, *Internal Combustion Engine Fundamentals*, McGraw-Hill, 2E. The textbook is not required for the class, just recommended. Detailed notes will be provided.

Attendance: Attendance to all lectures is mandatory. One unexcused absence allowable.

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

Exams: One midterm exam (Mon, Nov 14th, 2022 @ 4.25P – 5:45 PM). Required.
One final exam (Wed, Dec 7th, 2022 @ 8.30 - 11.00PM). 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: Mr. Amr Shaalan (amr.shaalan@stonybrook.edu)

Brightspace: We are using Brightspace, a digital learning environment, for this course. All homework assignments and solutions will be posted on the Brightspace course site. To learn more and for SUNY Online helpdesk 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, 128 ECC Building, (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.

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 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.

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
22-Aug	Mon	0		Chap. 0: Class Introduction, Syllabus		
24-Aug	Wed	1	1	Chapter 1: Applications; Basic Engine Design; Working Cycle;		
29-Aug	Mon	1		Chapter 1: Method Of Breathing, Valve and Port Design	HW #1	
31-Aug	Wed	1		Chapter 1: Fuels; Method of Mixture Prep, Ignition, and Comb; Method of Load Control		
5-Sep	Mon			**(No Class - Labor Day)**		
7-Sep	Wed	1	2	Chapter 1: Impact of IC Engines on Society		HW #1(9/9)
12-Sep	Mon	2	2	Chapter 2: Engine Geometry		
14-Sep	Wed	2	2	Chapter 2: Brake & Indicated Perf. Parameters,		
19-Sep	Mon	2	2	Chapter 2: Tuning & Performance Variable Relationships		
21-Sep	Wed	3	5	Chapter 3A: Ideal Models of Engine Processes and Cycles (closed cycle analysis)	HW# 2	
26-Sep	Mon	3		Chapter 3A: Ideal Models of Engine Processes and Cycles (closed cycle analysis)		
28-Sep	Wed	3	5	Chapter 3A: Ideal Models of Engine Processes and Cycles (closed cycle analysis)		
3-Oct	Mon	3	5	Chapter 3A/3B: Ideal Models of Engine Processes and Cycles (open/closed cycle analysis)		
5-Oct	Wed	3	5	Chapter 3B: Ideal Models of Engine Processes and Cycles (open cycle analysis)		HW #2 (10/07)
10-Oct	Mon			**(No Class - Fall Study Break)**		
12-Oct	Wed	3	5	Chapter 3B: Ideal Models of Engine Processes and Cycles (open cycle analysis)		
17-Oct	Mon	3	5	Chapter 3B: Ideal Models of Engine Processes and Cycles (open cycle analysis)	HW #3	
19-Oct	Wed	4	3	Chapter 4A: Combustion Thermodynamics - Air & Fuels, Comb. Stoichiometry, Dissociation		
24-Oct	Mon	4	3	Chapter 4A: Combustion Thermodynamics - Equilibirum Combustion Products, Practical Chemical Equilibrium		
26-Oct	Wed	4	3	Chapter 4A: Combustion Thermodynamics - Equilibirum Combustion Products, Practical Chemical Equilibrium		HW #3 (10/28)
31-Oct	Mon	4	3	Chapter 4B: Combustion Thermodynamics - 1st Law Analysis of Closed Reacting Systems, Enthalphy of Formation, Heating Value	HW #4	
2-Nov	Wed	4	3	Chapter 4B: Combustion Thermodynamics - 1st Law Analysis of Closed Reacting Systems, Enthalphy of Formation, Heating Value		
7-Nov	Mon	4&5	3 & 4	Chapter 4B: Combustion Thermodynamics , Chapter 5: Thermodynamic Properties of Engine Working Fluids,	Project Assigned	
9-Nov	Wed	5&6	3 &4	Chapter 5: Thermodynamic Properties of Engine Working Fluids, Chapter 6: Fuel-Air Cycle Ananlysis, Results, Efficiency & Performance, Computer Cycle Simulation, Comparison of Sim. & Actual Cycles		HW #4 (11/11)
14-Nov	Mon			MIDTERM	HW #5	
16-Nov	Wed	7	6	Chapter 7: SI Combustion - Features of the Combustion Process, Flame Structure & Turbulent Flame Propagation		
21-Nov	Mon	7	6	Chapter 7: SI Combustion - Lean Burn Engine Example, Flame Termination, MFB, Spark Timing, Combustion Abnormalities	HW #6	HW #5
23-Nov	Wed			**(No Class - Thanksgiving Break)**		
28-Nov	Mon	8	10	Chapter 8: CI Combustion - Diff from SI Engines, CI Engine Systems, Features of CI Combustion Process		
30-Nov	Wed	8	10	Chapter 8: CI Combustion - Ignition Dealy and Heat Release, Knock		HW #6
5-Dec	Mon	9	11	Chapter 9: Emissions Regulations, Gasoline Engine Aftertreatement, Diesel Engine Aftertreatement		Project Due
7-Dec	Wed			Final Exam 8:30-11PM		