ME 4823 Introduction to Automotive Engineering (Elective)

Catalog Description: ME 4823 Introduction to Automotive Engineering (3-0-3)

Prerequisites: ME 2202 Dynamics or Rigid Bodies, ME 3322 Thermodynamics, ECE 3710 Circuits & Electronics

Introduction to automotive engineering from a systems perspective. Major automotive systems and subsystems described together with appropriate engineering models. Topics include powerplants, engine management and emissions, transmissions and driveline components, steering/suspension systems and dynamics, braking systems and tires, automotive control and CAN, and emerging trends in automotive design.

Textbook: *Automotive Engineering: Powertrain, Chassis System and Vehicle Body*, Edited by David A. Crolla, 2009

References: *Automotive Engineering Fundamentals*, Richard Stone and Jeffrey K. Ball, SAE International, 2004

Topics covered (instructor-specific optional topics denoted by *):

1. Introduction & Overview
2. Automotive Powerplants: IC Engines and Thermodynamic Cycles (brief), Fuel Cells, Electric Machines
3. Engine Management & Emissions
4. Transmissions & Driveline: Clutches, Manual Transmissions, Automatic Transmissions, Continuously Variable Transmissions, Driveshafts, Differentials, Powertrain Layouts (FWD, RWD, AWD)
5. Steering Systems & Steering Dynamics
6. Suspensions & Suspension Design: Ride Comfort, Handling
7. Braking System & Tires
8. Automotive Controls & CAN
9. *Vehicle Dynamics: Dynamics, Stability
10. *Structural Design & Crashworthiness
11. Manufacturing
12. Simulation-Based Design: Performance and Fuel Economy
13. *Alternative Vehicles
14. *Sustainability
15. Emerging Technologies – e.g., Autonomous and Connected Vehicles
16. Course Summary

Course outcomes:

Outcome 1: To teach students the basic principles underlying the operation, control, and design of modern vehicle subsystems.

1.1 Students will demonstrate a basic technical understanding of the function, operation, and control of each subsystem of a vehicle.

1.2 Students will demonstrate the ability to perform basic calculations necessary to support the analysis and design of major automotive subsystems.

Outcome 2: To educate students on system-level modeling and simulation of vehicle performance

2.1. Students will learn backward- and forward-looking simulation techniques for deriving vehicle performance, such as acceleration performance and fuel economy.

2.2. Students will learn and apply specialized calculations for assessing subsystem performance, such as required in engine intake analysis, suspension design, and driveline characterization.

Outcome 3: To become acquainted with modern issues facing automotive engineering.

3.1. Students will become aware of the need for, and future of, alternative fuel and electric vehicles.

3.2. Students will be able to identify and address future needs in the automotive industry.

Correlation between Course Outcomes and Student Outcomes:

ME 48x3											
	Mechanical Engineering Student Outcome										
Course Outcomes	a	b	c	d	e	f	g	h	i	j	k
Course Outcome 1.1	X				X						X
Course Outcome 1.2	X				X						X
Course Outcome 2.1	X		X		X						X
Course Outcome 2.2	X		X		X						X
Course Outcome 3.1			X		X			X		X	X
Course Outcome 3.2	X		X		X		X	X		X	X

GWW School of Mechanical Engineering Student Outcomes:

(a) an ability to apply knowledge of mathematics, science and engineering
(b) an ability to design and conduct experiments, as well as to analyze and interpret data
(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
(d) an ability to function on multidisciplinary teams
(e) an ability to identify, formulate, and solve engineering problems
(f) an understanding of professional and ethical responsibility
(g) an ability to communicate effectively
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
(i) a recognition of the need for, and an ability to engage in life-long learning
(j) a knowledge of contemporary issues
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

Prepared by: Michael J. Leamy, January 24, 2017

LECT	DATE	SUBJECT	Reading
1	Jan 9	Introduction; Vehicle as a System of Systems	Supplemental
2	Jan 11	IC Engines 1 – Basic Operation and Thermodynamic Cycles	Chapter 1
3	Jan 13	IC Engines 2 – Spark Ignited	Chapter 1
4	Jan 18	IC Engines 3 – Compression Ignited	Chapter 1
5	Jan 20	Electric Machines 1 – DC	Supplemental
6	Jan 23	Electric Machines 2 – AC	Supplemental
7	Jan 25	Fuel Cells	Supplemental
8	Jan 27	Emissions Control 1	Chapter 3
9	Jan 30	Emissions Control 2	Chapter 3
10	Feb 1	Digital Engine Control 1	Chapter 4
11	Feb 3	Digital Engine Control 2	Chapter 4
12	Feb 6	EXAM 1	
13	Feb 8	Manual Transmissions and Clutches	Chapter 5
14	Feb 10	Automatic Transmissions	Chapter 5
15	Feb 13	Continuously Variable and Electrically Variable Transmissions	Chapter 5
16	Feb 15	Suspension & Drive 1	Chapter 8
17	Feb 17	Suspension & Drive 2	Chapter 8
18	Feb 20	Suspension & Drive 3	Chapter 8
19	Feb 22	Steering Systems 1	Chapter 9
20	Feb 24	Steering Systems 2	Chapter 9
21	Feb 27	Tire Mechanics and Handling 1	Chapter 10
22	Mar 1	Tire Mechanics and Handling 2	Chapter 11
23	Mar 3	Tire Mechanics and Handling 3	Chapter 11
24	Mar 6	Braking Systems 1	Chapter 12
25	Mar 8	Braking Systems 2	Chapter 12
26	Mar 10	Braking Systems 3	Chapter 12
27	Mar 13	Vehicle Motion Control 1 – Cruise Control	Chapter 15
28	Mar 15	Vehicle Motion Control 2 – Antilock Brakes & Suspension Control	Chapter 15
29	Mar 17	EXAM 2	
30	Mar 27	Vehicle Dynamics 1 – Long. Veh. Dynamics, Energy Consumption	Supplemental
31	Mar 29	Vehicle Dynamics 2 – Suspension Dynamics	Chapter 15
32	Mar 31	Vehicle Dynamics 3 – Steering Dynamics	Chapter 15
33	Apr 3	Vehicle Structural Mechanics 1	Chapter 16
34	Apr 5	Vehicle Structural Mechanics 2	Chapter 16
35	Apr 7	Vehicle Communications & CAN 1	Supplemental
36	Apr 10	Vehicle Communications & CAN 2	Supplemental
37	Apr 12	Hybrid-Electric, Electric, and Fuel Cell Vehicles 1	Chapter 7
38	Apr 14	Hybrid-Electric, Electric, and Fuel Cell Vehicles 2	Chapter 7
39	Apr 17	Hybrid-Electric, Electric, and Fuel Cell Vehicles 3	Chapter 7
40	Apr 19	Emerging Technologies 1 – Autonomous & Connected	Supplemental
41	Apr 21	Emerging Technologies 2 – Autonomous & Connected	Supplemental
42	Apr 24	Course Conclusion	
	May 5	Final Exam: 8:00am - 10:50pm	

Grading Plan:

GRADED EVENT	VALUE
Problem Sets	10%
Exam 1	25%
Exam 2	25%
Final Project	40%

The following minimum grades are guaranteed:

90.0% +	A
80.0% +	B
70.0% +	C
65.0% +	D
< 65%	F

Academic Misconduct: All students are expected to comply with the Georgia Tech Honor Code. Any evidence of cheating or other violations will be referred to the Dean of Students with a recommendation that the penalty be an award of zero points for the graded requirement, and a one letter grade reduction in the course. Cheating includes, but is not limited to: using unauthorized references or notes; copying directly from any source, including friends, classmates, tutors, or a solutions manual; allowing another person to copy your work; taking an exam or handing in a graded requirement in someone else's name, or having someone else take an exam or hand in a graded requirement in your name; or asking for a re-grade of a paper that has been altered from its original form.

Students with special needs: Please see me as soon as possible so that we can make appropriate arrangements.