

USM Mechanical Engineering

EME 432 Internal Combustion Engines

Spring 2010

Prof. Horizon Gitano

Syllabus

Rev. 4

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EME 432

Internal Combustion Engines

3 Credits

Instructor: Professor Horizon Gitano

Objectives:

The students should attain a fundamental understanding of the function of modern Internal Combustion Engines, including identification of each major component, knowledge of its function and how it relates to the other components in the engine. The student should also understand the basics of combustion chemistry, thermodynamics and heat transfer as applied to an ICE. Calculations of torque, power, efficiency, air/fuel ratio and fuel consumption will be required of students in the course. Finally an understanding of various new technologies in engine controls and their relations to fuel economy, vehicle dynamics, cost and emissions will be required.

Primary Text Book:

John B. Heywood, "*Internal Combustion Engine Fundamentals*", McGraw-Hill

Additional Reference Books:

Willard W. Pulkrabek, "*Engineering Fundamentals of the Internal Combustion Engine*", 2nd Edition, Pearson Prentice Hall

Eastop, T.D. and McConkey, A., "*Applied Thermodynamics for Engineering Technologies*", 5th edition, SI Units, Longman Publication, 1994

Winterbone, D.E., "*Advanced Thermodynamics for Engineers*", Arnold, 1997

Benson, R.S. & Whitehouse, N.D., "*Internal Combustion Engines*", Vol. 1-2, Pergamon, 1983

Grading:

Final Exam: 50%

Course Work:

Tests (2-3) 30% Total (Tests will be in normal classroom)

Homeworks (10) 2% each 20% Total (HWs due 1 week from assignment date)

NOTICE:

The following is the percentage breakdown of the letter grades:

A 90 to 100%

B 80 to 89.9%

C 70 to 79.9%

D 60 to 69.9%

F Below 60%

TO PASS THIS CLASS YOU MUST PASS BOTH THE COURSE WORK AND FINAL EXAM!

F + A = F F + B = F F + C = F F + D = F

Also Note: **PLAGIARISM = FAIL**. If you are caught copying you will fail the class.

Internal Combustion Engines

Course Outline (Chapter numbers refer to Heywood):

- Week 1** Introduction: OBE and Expected Outcomes
CH1 History of ICEs, Engine Classification
Fundamentals of Internal Combustion Engines
Slider-Crank Mechanism, Bore, Stroke, CR
- Week 2** Chemistry: Air Fuel Mixtures, Atomic Balance, Heat
CH2-3 AFR, Equivalence Ratio and Exhaust Products
- Week 3-4** Idealized Cycles: Compression, Expansion and Heat addition
CH4-5 Thermodynamics of Four Stroke Engines
Thermo of Two Stroke Engines
Torque, speed, Power, Overall Power Calculation
Break Mean Effective Pressure, BSFC
- TEST #1**
- Week 5-6** Fuel Mixing Techniques and Fuel Droplet Vaporization
CH9 Spark Ignition Engines: Carburetors, Fuel Injection, Direct Injection
Ignition Systems, Ignition Energy, Combustion Stability
CH10 Compression Ignition: Direct Injection, Indirect Injection
- Week 7** Gas Exchange process and Volumetric Efficiency
- Week 8-9** Turbulence and Flame Speed
CH7-8 In-Cylinders Bulk Flows
Flame Propagation
CH9 Abnormal Combustion: Knock, HCCI
CH6, 13 Friction
- TEST #2**
- Week 11-12** Performance, Economy and Emissions
Valve Timing
Intake/Exhaust Tuning
CH11 Exhaust Gas Recirculation
CH15 Super/Turbo Charging
Pollution and Catalysts
- Week 13-14** Electronic Engine Controls: Sensors, Actuators
Dynamometry: Engine Testing and Measurements
Hybrid Vehicle Systems: Parallel-Series, Power and Energy
Alternate Fuels: Costs, Advantages and Disadvantages
- TEST #3**

Review for Final Exam