

## **ME 4011 Internal Combustion Engines (Elective)**

(Prior to 01/08 it was Special Topics ME 4803)

**Catalog Description:** ME 4011 Internal Combustion Engines (3-0-3)  
Prerequisite: ME 3322 Thermodynamics  
Analysis and design of various types of engines used in transportation systems.  
Topics include advances in energy efficiency and emissions in automotive applications.

**Textbook:** Pulkrabek, W. W., Engineering Fundamentals of the Internal Combustion Engine, 2<sup>nd</sup> ed., Pearson Prentice-Hall, 2004.

### **Topic Covered:**

1. Introduction and application survey
2. Operating characteristics
3. Engine cycles and analysis
4. Thermochemistry and fuels
5. Air and fuel induction
6. Combustion chamber fluid flow
7. Combustion
8. Exhaust flow
9. Emissions
10. Heat transfer
11. Engine dynamics
12. Friction, lubrication and wear

### **Course Outcomes:**

Outcome 1: To teach students the operating characteristics and thermodynamic analysis of common internal combustion engine cycles

- 1.1 Students will demonstrate knowledge of the operating characteristics of common IC engines.
- 1.2 Students will demonstrate the ability to perform a thermodynamic analysis of Otto, Diesel and Dual cycle models.

Outcome 2: To teach students to analyze the combustion process of common fuels

- 2.1 Students will demonstrate knowledge of the characteristics of common liquid and gaseous fuels.
- 2.2 Students will demonstrate the ability to perform a combustion analysis of these fuels in the basic cycles.
- 2.3 Students will demonstrate an understanding of the generation of undesirable exhaust emissions and methods used to reduce them.

Outcome 3: To make students aware of the roles of fluid flow and heat transfer in engine operation

- 3.1 Students will demonstrate an understanding of the air and fuel induction processes
- 3.2 Students will demonstrate an understanding of fluid flow in the combustion chamber and exhaust system.
- 3.3 Students will demonstrate an understanding of the various heat transfer mechanisms in the engine.

Outcome 4: To teach students methods to mitigate engine vibration, friction and wear

- 4.1 Students will demonstrate the ability to analyze engine vibration and balancing mechanisms.  
 4.2 Students will demonstrate an understanding the role of lubrication in reducing friction and wear.

Outcome 5: To teach students the environmental, social and technological issues related to the future wide-spread use of internal combustion engines

5.1 Students will demonstrate an understanding of environment impacts of wide-spread use of internal combustion engines.

5.2 Students will demonstrate an understanding of technological, environmental, and social impacts of alternative fuels

### Contribution of course to meeting the requirements of Criterion 5.

| ME 4011            |   |   |   |   |   |   |   |   |   |   |   |   |
|--------------------|---|---|---|---|---|---|---|---|---|---|---|---|
|                    | Mechanical Engineering Program Educational Outcomes |   |   |   |   |   |   |   |   |   |   |   |
| Course Outcomes    | a   | b | c | d | e | f | g | h | i | j | k | l |
| Course Outcome 1.1 | X   |   |   |   |   |   |   |   |   |   |   | X |
| Course Outcome 1.2 | X   |   |   |   | X |   |   |   |   |   | X | X |
| Course Outcome 2.1 | X   |   |   |   |   |   |   |   |   | X |   | X |
| Course Outcome 2.2 | X   |   |   |   | X |   |   |   |   | X | X | X |
| Course Outcome 2.3 | X   |   |   |   | X | X |   | X |   | X | X | X |
| Course Outcome 3.1 | X   |   |   |   | X |   |   |   |   |   | X | X |
| Course Outcome 3.2 | X   |   |   |   | X |   |   |   |   |   | X | X |
| Course Outcome 3.3 | X   |   |   |   | X |   |   |   |   |   | X | X |
| Course Outcome 4.1 | X   |   |   |   | X |   |   |   |   |   | X | X |
| Course Outcome 4.2 | X   |   |   |   | X |   |   |   |   |   | X | X |
| Course Outcome 5.1 | X   |   |   |   |   | X |   | X | X | X |   | X |
| Course Outcome 5.2 | X   |   |   |   |   | X |   | X | X | X |   | X |