

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

**Catalog Description:** ME 4011 Internal Combustion Engines (3-0-3)  
Prerequisites: ME 3322 Thermodynamics  
Corequisites: ME 3345 Heat Transfer  
Analysis and design of various types of engines used in transportation systems. Topics include advances in energy efficiency and emissions in automotive applications.

**Textbook:** Willard W. Pulkrabek, *Engineering Fundamentals of the Internal Combustion Engine*, 2nd Edition, Pearson Prentice Hall, 2004.

### **Topics 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.

**Correlation between Course Outcomes and Student Outcomes:**

<b>ME 4011</b>											
	<b>Mechanical Engineering Student Outcomes</b>										
<b>Course Outcomes</b>	<b>a</b>	<b>b</b>	<b>c</b>	<b>d</b>	<b>e</b>	<b>f</b>	<b>g</b>	<b>h</b>	<b>i</b>	<b>j</b>	<b>k</b>
Course Outcome 1.1	X										
Course Outcome 1.2	X				X						X
Course Outcome 2.1	X										
Course Outcome 2.2	X				X						X
Course Outcome 2.3	X				X	X		X		X	X
Course Outcome 3.1	X				X						X
Course Outcome 3.2	X				X						X
Course Outcome 3.3	X				X						X
Course Outcome 4.1	X				X						X
Course Outcome 4.2	X				X						X
Course Outcome 5.1	X					X		X	X	X	
Course Outcome 5.2	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