

**King Fahd University of Petroleum & Minerals**  
**MECHANICAL ENGINEERING DEPARTMENT**  
**ME 422: Propulsion Systems**

**Catalogue Description:** (3-0-3)

Aerothermodynamics of aerospace vehicle engines, combustion, thrust and efficiency. Gas turbine engines: Turbojet, turbofan, turboprop; Ramjet and scramjet, typical engine performance. Aerothermodynamics of inlets, combustors and nozzles. Introduction to propellers, turbo compressors and turbines. Introduction to rockets and performances of rocket vehicle engines. Chemical and electrical driven rocket engines.

**Status in Curriculum (Required or Elective):** Elective (offered Fall or Spring)

**Prerequisites:** Thermodynamics II (ME 204) & Fluid Mechanics (ME 311)

**Co-requisites:** None

**Prerequisites by Topics:**

- Power Cycles (ME204)
- Thermodynamics of Combustion (ME204)
- Fluid Mechanics (ME311)

**Textbook:** Hill, P., and Peterson, C., Mechanics and Thermodynamics Of Propulsion Systems, Addison-Wesley Pub. Ltd., 1992.

**References:**

- Archer, R. D., and Saarlal, M., An Introduction to Aerospace Propulsion, Prentice Hall Publisher, 1996.
- Oates, G. C., Aerothermodynamics of Gas Turbine and Rocket Propulsion.

**Coordinator:** Dr. Bekir S. Yilbas, Professor of Mechanical Engineering

**Goals:(general objectives)**

1. Teach students the basic concepts in the propulsion systems through the law of Fluid Mechanics and Thermodynamics, the means by which the energy transfer is achieved in the chief types of RAM jets, compressors, turbines together with the differing behavior of individual types in operation as related to solving engineering problems in propulsion systems.
2. Provide students with a working knowledge of practical applications of propulsion systems, RAM jets, air breathing engines, compressors, turbines, combustors and related problems.
3. Provide design experience through introducing the geometric configuration of the intakes, compressors, turbines, kinematics relations, and work and power estimations.

**Course Outline (Lecture Topics):**

1. Mechanics and Thermodynamics of Fluid Properties. (3 hours)
2. Thermodynamics of Aircraft Jet Engines. (6 hours)
3. Aerothermodynamics of Inlets, Combustors, and Nozzles. (3 hours)
4. Axial Compressors. (9 hours)
5. Axial Turbines. (6 hours)
6. Centrifugal Compressors. (6 hours)
7. Performance of Rocket Vehicles. (6 hours)
8. Chemical Rocket Thrust Chambers and Chemical Rocket Propellants. (6 hours)
9. Applications of propulsion systems to engineering problems. (6 hours)
10. Preliminary design fundamentals of propulsion systems and three-dimensional considerations. (3 hours)

**Design Activities/Projects:**

A design project is assigned which can be considered a “practicum” and integrates previous student work in a practical setting.

**Computer Usage:**

Students are encouraged to solve some assigned homework problems using the available engineering software, such as MATLAB

**Laboratory:** None

### Assessment Tools:

- i- Mid-term Examinations
- ii- Homework Assignments
- iii- Term Project
- iv- Final Exam

### Course Learning Outcomes:

- I- Demonstrate a basic understanding of laws of fluid flow and thermodynamics in association with the propulsion system.
- II- Tackle propulsion problems associated with industry.
- III- Design some parts in propulsion systems.
- IV- Develop computational skills to analyze and design of components such as intakes, compressors, diffusers, and gas turbines.

### Course Learning Outcomes mapped to Student Outcomes:

Student Outcomes	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>g</i>	<i>h</i>	<i>i</i>	<i>j</i>	<i>k</i>
Course-to-Student outcome mapping	I, II, III, IV	I, II, III, IV	II, IV		III, IV	I, II, III, IV	I, II, III, IV	II, VI	II, III, IV	II, IV	I, II, III, IV
Emphasis*	S	S	M	L	M	S	S	M	M	M	S

\* L:: Little/None                      M: Moderate                      S: Strong

### Status of Continuous Improvement review of this Course:

**Date reviewed:** March 2, 2015  
**Prepared by:** Dr. Ahmet Z. Sahin

**Reviewed by:** Dr. Ahmet Z. Sahin  
**Date prepared:** February 27, 2015