MAE 113
Fundamentals of Propulsion (4 units)

Class/Laboratory Schedule: four hours of lecture, eight hours of outside preparation.
12 hours/week total

Course Coordinator(s): Antonio Sanchez

Textbooks/Materials:

1. Hill & Peterson, Mechanics and Thermodynamics of Propulsion, (2nd Edition), Addison-Wesley, New York, 1992

Catalog Description: Compressible flow, thermodynamics, and combustion relevant to aircraft and space vehicle propulsion. Analysis and design of components for gas turbines, including turbines, inlets, combustion chambers and nozzles. Fundamentals of rocket propulsion.

Prerequisites: MAE 110A or CENG 102, and MAE 101A or CENG 101A, and MAE 101B or CENG 101C. Enrollment restricted to MC 25, MC 27, and MC 28 majors only.

Course Type: Required

Performance Criteria:
Objective 1
1.1 Student will demonstrate ability to apply principles of analysis to formulate and solve problems involving air breathing engines

Objective 2
2.1 Student will demonstrate ability to apply principles of analysis to formulate and solve problems involving rockets

Objective 3
3.1 Student will demonstrate ability to analyze performance of cycles

Objective 4
4.1 Students will demonstrate ability to select appropriate propulsion devices for a given application

Objective 5
5.1 Students will demonstrate ability to analyze individual components

Objective 6
6.1 Students will demonstrate familiarity and understanding of system performance

Course Objectives:
(Numbers in parenthesis refer to MAE Program Outcomes)

1. Provide students with an understanding of the use of thermodynamics, transport processes, and compressible flow fundamentals in the operation of air breathing engines (gas turbines). (1, 2, 4, ME10, ME11, AE12)

2. Provide students with an understanding of the use of thermodynamics, transport processes, and compressible flow fundamentals in the operation of rockets. (1, 2, 4, ME10, ME11, AE13)

3. Provide students with the ability to analyze the performance of gas turbine cycles and rocket engine cycles for propulsion. (1, 2, ME11, AE12, AE13, AE14)

4. Provide students with the ability to select appropriate propulsion devices (ramjet, turbojet, turbofan, turboprop, rocket) for a given application. (1, 2, 6, ME8, ME9, ME11)

5. Provide students with the ability to analyze the operation of individual components of a gas turbine and rocket: inlets, compressor, combustor, turbine, afterburner, and nozzle. (1, 2, ME10, ME11, AE12, AE13, AE14)

6. Provide students with the ability to appreciate the influence of the performance of the components of the gas turbine and rocket engines on the system performance. (2, 4, 5, 7, ME11, AE14)

Course Topics:
1. The jet propulsion principle. Types of Engines. Performance parameters
2. Mechanics and thermodynamics of fluid flow. Mass, momentum, and energy equations. Thermodynamics of gases.
3. Introduction to compressible flow. The Mach number. Steady ideal flow of a gas. Shock waves. Expansion waves.
4. Ramjets.
5. Turbojets.
6. Turbofans.
7. Turboprops and Turboshafts

8. Typical engine performance. Engine-aircraft matching.
9. Rockets.
10. High-speed combustion. SCRAMJETS

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