AE245 Aug 3:0

Mechanics and Thermodynamics of Propulsion

Instructor

Swetaprovo Chaudhuri
Email: schaudhuri@iisc.ac.in

Teaching Assistant

Email:

Department: Aerospace Engineering

Course Time: Tue., Thu., 11:30 - 1:00 PM

Lecture venue: AE106

Detailed Course Page:

Announcements

Brief description of the course

In this course, the engineering and scientific aspects of aerospace propulsion are delicately balanced. The course is designed for fresh, entry level graduate students. In addition to the topics covered in a general propulsion course, including but not limited to Reynolds transport theorem towards thrust equation, real cycle analysis of ramjets, scramjets, turbojets and turbofans, we cover topics like introduction to statistical thermodynamics, boundary layer theory, combustion to engineering analysis of components like combustors, intakes, compressors and turbines. In an advanced engineering course, such a balance of science and technology is crucial towards the holistic development of the students.

Prerequisites

UG Fluid Mechanics and Thermodynamics

Syllabus

AE 245: Mechanics and Thermodynamics of Propulsion

1. Fundamentals

Conservation Laws for System and Control Volume â€“ Reynolds Transport Theorem

1st Law for System and CV, 2nd Law for System and CV

Thermodynamic Cycles and Brayton Cycle Analysis

1D Flow of a Perfect Gas

1D Isentropic and Non-isentropic Flows

Review of Classical Thermodynamics

Statistical Thermodynamics

2. Air Breathing Engines: Global Description and Cycle Analysis

Efficiency and Range

1D Energy Equation with combustion

Ramjet

Scramjet

Turbojet

Turbofan

Turboprop

Turbine Based Combined Cycle

3. Component Analysis: Aerothermodynamics of Inlets, Combustors and Nozzles

Inlets

Gas Turbine Combustors

Spray and Combustion

Afterburners

Exhaust Nozzles

4. Introduction to Turbomachinery

Boundary Layer Theory

Axial Compressors

Radial Compressors

Thermal Boundary Layers

Axial Turbines

Course outcomes

Strong grasp in fundamentals of Air Breathing Aero Engines: overall cycle analysis as well as component based analysis

Grading policy

Mid term Exam (30%), Final Exam (50%), Project (20%)

Assignments

Resources

Mechanics and Thermodynamics of Propulsion by Hill and Peterson
Fundamentals of Fluid Mechanics by Munson and Okiishi
Fundamentals of thermodynamics by Sonntag, Borgnakke, and Van Wylen
Thermodynamics by Cengel and Boles
Gas Turbine Theory by Saravanamuttoo, Rogers, Cohen, Straznicky.
Gas Turbine Combustion by Lefebvre and Ballal
The Scramjet Engine by Corin Segal
Combustion Physics by Law
H. B. Callen, Thermodynamics and Introduction to Thermostatics
Statistical Thermodynamics by Normand M. Laurendau.