

# Advanced Propulsion (AEPC3005)

## Course Objectives

- To develop an understanding of advanced air-breathing and rocket propulsion systems
- To analyze high-speed combustion, hypersonic propulsion, and space propulsion
- To study modern propulsion technologies (electric, nuclear, hybrid systems)
- To enable design-oriented thinking in propulsion systems

## Course Outcomes

After completing the course, students will be able to:

- Analyze advanced propulsion systems performance
- Understand hypersonic and space propulsion concepts
- Design basic rocket and air-breathing systems
- Evaluate modern propulsion technologies and sustainability aspects

## Prerequisites

- Thermodynamics
- Fluid Mechanics
- Compressible Flow
- Basic Propulsion

## Module 1: Review of Propulsion Fundamentals (06 Hours)

Review of thermodynamics and compressible flow, Brayton cycle and propulsion efficiency, Thrust equation and performance parameters, Specific impulse, TSFC, propulsive efficiency, Nozzle flow (isentropic & non-isentropic)

## Module 2: Advanced Air-Breathing Engines (06 Hours)

Ramjet: working principle, performance, limitations; Scramjet: supersonic combustion, design challenges; Pulse detonation engines (PDE), Combined cycle engines (RBCC, TBCC), Hypersonic propulsion concepts

### **Module 3: Supersonic Combustion & High-Speed Flows (06 Hours)**

Fundamentals of supersonic combustion, Flame stabilization techniques, Mixing and ignition challenges, Shock–flame interactions, Combustor design considerations

### **Module 4: Space & Electric Propulsion Systems (06 Hours)**

Electric propulsion: Ion thrusters, Hall effect thrusters, Plasma propulsion; Nuclear propulsion basics, Solar sail propulsion, Satellite propulsion systems

### **Module 5: Emerging & Sustainable Propulsion (06 Hours)**

Green propellants and sustainability, Hydrogen propulsion, Biofuels in aviation, Hybrid-electric propulsion, Environmental impact (NO<sub>x</sub>, CO<sub>2</sub> reduction), Future propulsion technologies

### **Textbooks**

1. Mechanics and Thermodynamics of Propulsion by Hill & Peterson.
2. Rocket Propulsion Elements by Sutton
3. Elements of Propulsion by Mattingly
4. Hypersonic and High Temperature Gas Dynamics by Anderson