# JET AND ROCKET PROPULSION
# (Professional Elective IV)

II Semester

**Course Code:** 19ME2258

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**Prerequisites:** Engineering Thermodynamics

**Course Outcomes:** At the end of the course, the student will be able to

CO1: Explain the working of jet engines and rocket propulsion systems.
CO2: Explain liquid propellant rocket engines.
CO3: Discuss solid propellant rocket engines and explain rocket motor design approach.
CO4: Classify solid propellants and discuss the characteristics.
CO5: Explain the working of hybrid propellant rockets and select the process for rocket propulsion systems.

**UNIT-I:** **(10-Lectures)**

Ramjet engine, pulse jet engine, turboprop engine, turbojet engine, thrust and thrust equation, specific thrust of turbojet engine, specific thrust of the turbojet engine, efficiencies, parameters effecting the flight performance, thrust augmentation. Duct jet propulsion, rocket propulsion, chemical rocket propulsion, nuclear rocket engines, electric rocket propulsion, applications of rocket propulsion-space launch vehicles, spacecraft, missiles and other applications.

Learning outcomes: At the end of this unit, the student will be able to

1. Explain working of jet engines. (L2)
2. Summarize performance characteristics of jet engines. (L2)
3. Define rocket propulsion systems. (L1)

**UNIT-II:** **(10-Lectures)**

Liquid propellant rocket engine-propellants, propellant feed systems, gas feed systems, propellant tanks, tank pressurization, turbo pump feed system and engine cycles, flow and pressure balance, valves and pipelines, engine support structure. Liquid Propellant properties, liquid oxidizers, liquid fuels liquid monopropellants, gelled propellants, combustion process, analysis, combustion instability.

Learning outcomes: At the end of this unit, the student will be able to

1. Discuss liquid propellant, feed systems in rocket engines. (L6)
2. Explain propellant properties. (L2)
3. Distinguish propellants and analyse combustion process. (L4)

**UNIT-III:** **(10-Lectures)**

Solid propellant rocket engine - propellant burning rate, basic performance relations, propellant grain and grain configuration, propellant grain stress and strain, attitude control. Motor case – metal cases, wound – filament –reinforced plastic cases, nozzles- classification, design and construction, heat absorption and nozzle materials, rocket motor design approach.

Learning outcomes: At the end of this unit, the student will be able to

1. Discuss solid propellant rocket engine. (L6)
2. Explain performance relations propellant grain configuration. (L2)
3. Classify nozzles and nozzle materials. (L2)

**UNIT-IV: (10-Lectures)**

Solid propellants-classification, propellant characteristics, propellant ingredients, smokeless propellant, igniter propellants, physical and chemical processes, ignition process, extinction or thrust termination, combustion instability.

Learning outcomes: At the end of this unit, the student will be able to

1. List solid propellants. (L1)
2. Discuss propellant characteristics, smokeless propellant. (L6)
3. Analyze ignition process, thrust, combustion stability. (L4)

**UNIT-V (10-Lectures)**

Hybrid propellant rockets - applications and propellants, performance analysis and grain configuration, combustion instability. Rocket propulsion systems - selection process, criteria for selection, interfaces.

Learning outcomes: At the end of this unit, the student will be able to

1. Explain hybrid propellant rockets. (L2)
2. Analyse performance, grain configuration. (L4)
3. Summarize selection, criteria for selection of rocket propulsion systems. (L2)

**TEXT BOOKS:**

1. George P. Sutton and Oscar Biblaz, *Rocket Propulsion Elements*, Ninth Edition, Wiley-Interscience, 2017.

**REFERENCE BOOKS:**

1. Philip Hill and Carl Peterson, *Mechanics and Thermodynamics of Propulsion*, Second Edition, Pearson Education, 2009.
2. V Ganesan, *Gas Turbines*, 3rd Edition, Tata McGraw-Hill Education, 2010.