GAS DYNAMICS AND JET PROPULSION

Course Code	20ME4702C	**Year**	IV	**Semester**	I
Course Category	Professional Elective- IV	**Branch**	ME	**Course Type**	Theory
Credits	3	**L-T-P**	3-0-0	**Pre-requisites**	Thermodynamics, Heat Transfer, Fluid Mechanics
Continuous Internal Evaluation	30	**Semester End Evaluation**	70	**Total Marks**	100

Course Outcomes: Upon successful completion of the course, the student will be able to

	Statement	**Skill**	**BTL**	**Units**
CO1	Understand basic concepts of flow and propulsion theory	Understand	L2	1,2,3,4,5
CO2	Apply the flow and shock theories on various ducts	Apply	L3	2,3
CO3	Analyze the performance of various propulsion techniques	Analyze	L4	4,5

Contribution of Course Outcomes towards achievement of Program Outcomes
Strength of correlations (3: High, 2: Moderate, 1: Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1					2					2	3	1
CO2	3	1					2					2	3	1
CO3	3	2					2					2	3	1

Syllabus

UNIT	**Contents**	**Mapped COs**
I	**BASIC CONCEPTS OF COMPRESSIBLE FLOW** Introduction: Why study Gas dynamics, Mach number, and flow regimes, Thermodynamics Review of basics, Calorifically perfect gas, and Thermally perfect gas. Compressible fluid flow- Energy and momentum equations, stagnation stages, various regions of flow, reference velocities, effect of Mach number on compressibility. Types of waves, Mach cone, Mach angle.	**CO1**
II	**FLOW THROUGH DUCTS** Flow through variable area ducts-Nozzles and diffusers, Mach number variation, stagnation and critical states, area ratio as a function of Mach number. Flow through constant area ducts-Flow through constant area ducts with friction (Fanno flow), with heat transfer (Rayleigh flow), Variation of flow properties. Use of Gas Tables and Charts.	**CO1, CO2**
III	**NORMAL AND OBLIQUE SHOCKS** Normal Shock Wave: Principle and derivation of flow properties across the normal shock, Rayleigh Pitot formula, Moving Shock Wave and its Reflection, Use of Tables and Charts. Oblique Shock Wave: Prandtl Meyer Expansion, Shock-expansion analysis of diamond airfoil, Unsteady 1D flow and the shock tube	**CO1, CO2**
IV	**PROPELLER THEORIES & JET PROPULSION** Propeller Theories: Types of propeller, Propeller thrust: momentum theory, Blade element theories, propeller blade design, propeller selection.	**CO1, CO3**

	Jet Propulsion: Illustration of working of gas turbine engine – The thrust equation – Factors affecting thrust – Effect of pressure, velocity and temperature changes of air entering compressor – Methods of thrust augmentation – Characteristics of turboprop, turbofan and turbojet – Performance characteristics.	
V	**INTRODUCTION TO ADVANCED PROPULSION TECHNIQUES** Introduction to Rocket Propulsion: Types of rocket engines, propellants, combustion instabilities, rocket propulsion theory, performance of rocket engine, multistage rockets, orbital and escape velocities. Advanced Propulsion techniques: Hybrid propellant rocket - Electrical rockets - Electro-thermal, Electro-static and Electro-magnetic propulsion system - arc-jet thruster - Ion thruster - Hall Effect Thruster - Magneto plasma dynamic thruster - Nuclear rockets - solar Propulsion system.	**CO1, CO3**

Learning Resources

Text books

1. Yahya S.M. Fundamentals of Compressible Flow, New Age International (P) Ltd., New Delhi, 2003.
2. Ganesan V, Gas Turbines, Tata McGraw-Hill Publishing Company Ltd., 2003.

Reference books

1. Philip G Hill and Carl R. Peterton, Mechanics and Thermodynamics of Propulsion, Addison-Wesley Publishing Company, 1999.
2. Khajuria P.R and Dubey S.P., Gas turbines and Propulsive Systems, Dhanpat Rai Publications (P) Ltd, New Delhi 2003.
3. Cohen H. Rogers GFC, Saravanamuttoo HIH, Gas Turbines Theory, Addison-Wesley Long man Ltd., 2001.

Resources & other digital material

1.https://onlinecourses.nptel.ac.in/noc22_ae05/preview