

3ME44: GAS DYNAMICS AND PROPULSIVE SYSTEMS
CREDITS - 4 (LTP: 3,1,0)

Course Objective:

To analyze compressible flow through constant and variable area duct and propulsive system by applying principles of Fluid mechanics.

Teaching and Assessment Scheme:

Teaching Scheme (Hours per Week)			Credits	Assessment Scheme				Total Marks
L	T	P	C	Theory Marks		Practical		
				ESE	CE	ESE	CE	150
3	1	0	4	60	40	20	30	

Course Contents:

Unit No.	Topics	Teaching Hours
1	Fundamentals of Compressible Flow: Basic equations of compressible flow: Continuity equation, Energy equation and Momentum equation; stagnation states, Mach wave and Mach cones, effect of Mach number on compressibility.	6
2	Flow through variable area duct: One dimensional isentropic flow in duct of varying cross sectional area; flow through convergent and convergent- divergent nozzles, analysis of flow through nozzle by using property tables, analysis of flow through diffuser; critical properties and choking of nozzle	10
3	Normal shock waves: Development of shock wave, thickness of shock wave, strength of shockwave, Prandtl relation, Rankine- Hugoniot relation, variation of flow parameter across the normal shock.	6
4	Flow in constant area duct with friction (Fanno flow): Fanno flow equation and its solution, relation of flow properties with length, graphical presentation of flow properties, experimental coefficient of friction, preliminary design of the duct.	6
5	Flow in constant area duct with heat transfer (Rayleigh flow): Rayleigh flow equations and its solution, variation of flow properties with length of duct, analysis for maximum heat transfer, preliminary design of the duct.	6
6	Theory of jet propulsion: Operating principle of Propulsive systems; Propulsive, Thermal and Overall efficiency, specific fuel consumption, thrust equation and cycle analysis; performance and salient features of ram jet, turbojet, turbofan and turboprop engines, practical application of engines.	8
Total		42

List of References:

1. S. M. Yahya, "*Fundamentals of Compressible flow with Aircraft and Rocket Propulsion*" *Third Edition*, New age international Publication.
2. P. Balachandran, "*Fundamentals of Compressible fluid dynamics*", PHI Learning, New Delhi.
3. E. Rathakrishnan, "*Gas Dynamics*", *Second Edition*, PHI Learning Pvt Ltd,
4. P. Murugaperumal, "*Gas Dynamics and Jet Propulsion*" *Third Edition*, SciTech Publication, Chennai.
5. The Ascher H. Shapiro, "*Dynamics and thermodynamics of Compressible fluid flow Volume-I*", The Ronald Press Company, New York.
6. J. D. Anderson, "*Modern Compressible Flow*", *Third Edition*, McGraw Hill, 2003.

Course Outcomes (COs)

At the end of this course students will be able to ...

1. Apply governing equations to practical problems involving compressible fluid flow.
2. Analyze compressible flow through variable area duct critically.
3. Analyze compressible flow having Normal shock by using different relations.
4. Apply governing equations to compressible flow through constant area duct with friction and flow through constant area duct with heat transfer.
5. Interpret propulsive systems for their working and application.

