Devi Ahilya University, Indore, India Institute of Engineering & Technology				**IV Year B.E. (Mechanical Engg.) (Full Time)**			
Subject Code & Name	**Instructions Hours per Week**			**Credits**			
MER8E5	**L**	**T**	**P**	**L**	**T**	**P**	**Total**
GAS DYNAMICS	**3**	**1**	**2**	**3**	**1**	**1**	**5**
Duration of Theory Paper: 3 Hours							

Learning Objectives:

1. The objective of the subject is to acquaint the students about the fundamental principles of fluid mechanics.
2. The objective of the subject is to acquaint the students about the fundamental principles of thermodynamics and compressibility.
3. The objective of the subject is to acquaint the students about the fundamental principles of different types of flows.

Pre requisite(s): Fluid Mechanics, Thermodynamics, Heat Transfer.

COURSE CONTENTS

UNIT-I

Introduction

Compressible flow, energy equation, rate equations for control volume, speed of sound –in ideal and perfect gases, in real gases, in almost compressible liquid, in solids, in two phase medium.

UNIT-II

Isentropic Flow with variable area

Comparison of isentropic and adiabatic processes, Mech number variation, stagnation and critical states, Area ratio as function of Mech number, impulse function, Mass flow rate, flow through nozzles, flow through diffusers.

UNIT-III

Flow with Normal Shock Waves

Wave Motion- Wave propagation in an elastic solid medium, sound waves, pressure waves, expansion waves. Development of shock waves, rarefaction waves, governing equations, prandtl-Mayer relation Mach no. downstream of normal shock wave, static pressure ratio across the shock, temperature ratio across the shock, density ratio across the shock, stagnation pressure ratio across the shock, change in entropy across the shock, impossibility of shock in subsonic flow, strength of a shock wave Moving normal shock waves.

UNIT-IV

Flow with oblique shock wave

Nature of flow, fundamental relations, prandtl equation, Rankine-Hugoniot equation, Oblique shock relations, Mach Waves.

UNIT-V

Flow in constant area ducts with friction

Fanno curves, flow equations, solution of fanno flow equations, variation of flow properties and Mach no. with duct length, Isothermal flow. Flow in constant area duct with heat transfer: Reyleigh line, fundamental equations, Reyleigh flow relations, variation of flow properties, Maximum heat transfer.

Learning Outcomes:

Upon Completing the Course, Student will able to:

1. Understand the phenomenon of compressible liquids.
2. Understand the phenomenon of flow through nozzles & diffusers.
3. Understand the phenomenon of sound waves.
4. Understand the phenomenon of shock waves.
5. Understand the principles of Flow in constant area ducts with friction.
6. Understand Behavior of Gas under various conditions.

7. Use the Gas tables
8. Understand basics of compressible flow
9. Correlate fundamentals of Gas Dynamics with various mechanical systems

BOOKS RECOMMENDED:

[1] Bird G. A., *Molecular Gas Dynamics and the Direct Simulation of Gas Flows*, Oxford University.
[2] Carlo C., *Kinetic Theory and Gas Dynamics*, Springer Verlog.
[3] Liepmann H., *Elements of Gas Dynamics* , Dover Publication.
[4] Rathakrishnan E. *Gas Dynamics* Prentice Hall of India.
[5] Yahya S.M., *fundamentals of compressible flow*, Wieley Eastern Limited New Delhi.

LIST OF PRACTICAL ASSIGNMENTS

1. Analysis of Mass flow rate through nozzles.
2. Study of variation of flow properties and Mach no. with duct length
3. Analysis of Heat Transfer through constant area duct.
4. Study & Analysis of Heat Transfer through fins.
5. Analysis of friction loss through constant area ducts.
