

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 GAS DYNAMICS	L	T	P	L	T	P	Total
	Duration of Theory Paper: 3 Hours	3	1	2	3	1	1

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 Verlag.
- [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*, Wiley 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.
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Looking for Gas Dynamics? Find out information about Gas Dynamics. The study of gases in motion. In general, matter exists in any of three states: solid, liquid, or gas. Liquids are incompressible under normal conditions; Explanation of Gas Dynamics Gas dynamics is a science in the branch of fluid dynamics, concerned with the study of motion of gases and its effects on physical systems. Based on the principles of fluid mechanics and thermodynamics, gas dynamics arises from the studies of gas flows in transonic and supersonic flights. To distinguish itself from other sciences in fluid dynamics, the studies in gas dynamics are often defined with gases flowing around or within physical objects at speeds comparable to or exceed the speed of sound and Gas Dynamics. Quizlet is the easiest way to study, practise and master what you're learning. Create your own flashcards or choose from millions created by other students. Fluid Statics. It encompasses the study of the conditions under which fluids are at rest in stable equilibrium. Fluid Dynamics. Deals the study of the movement of fluids, including their interaction as two fluids come into contact with each other. Kinematics. From Gas Dynamics, Third Edition, by James E. John and Theo G. Keith. ISBN 0-13-120668-0. © 2006 Pearson Education, Inc., Upper Saddle River, NJ. Problem 2. " (a) Show that p/ρ has units of velocity squared. (b) Show that p/ρ has the same units as h (kJ/kg). (c) Determine the units conversion factor that must be applied to kinetic energy, $V^2/2$, (m^2/s^2) in order to add this term to specific enthalpy h (kJ/kg). 1. From Gas Dynamics, Third Edition, by James E. John and Theo G. Keith. ISBN 0-13-120668-0.