



CVM
UNIVERSITY

Aegis: Charutar Vidya Mandal (Estd.1945)

FACULTY OF ENGINEERING & TECHNOLOGY

Effective from Academic Batch: 2022-23

Programme: Bachelor of Technology (Mechanical Engineering)

Semester: VIII

Course Code: 202090802

Course Title: Gas Dynamics

Course Group: Professional Elective Course - V

Course Objectives: The course is to analyze compressible flow through constant and variable area duct and propulsive system by applying principles of Fluid mechanics.

Teaching & Examination Scheme:

Contact hours per week			Course Credits	Examination Marks (Maximum / Passing)				Total
Lecture	Tutorial	Practical		Theory		J/V/P*		
				Internal	External	Internal	External	
3	0	2	4	50 / 18	50 / 17	25 / 9	25 / 9	150/53

* J: Jury; V: Viva; P: Practical

Detailed Syllabus:

Sr. No.	Contents	Hours
1	Fundamentals of compressible flow: Ideal gas relationship, The adiabatic energy equation, Mach number and its significance, Mach waves, Mach cone and Mach angle, static and stagnation states, relationship between stagnation temperature, pressure, density and enthalpy in terms of Mach number, stagnation velocity of sound, reference speeds, various regions of flow, Effect of Mach number on compressibility, Area velocity relationship.	7
2	One Dimensional Isentropic flow: General features of isentropic flow, performance curve, Comparison of adiabatic and isentropic process, One dimensional isentropic flow in ducts of varying cross-section- nozzles and diffusers, operation of nozzles under varying pressure ratio, mass flow rate in nozzles, critical properties and choking, area ratio as function of Mach number, Impulse function, non-dimensional mass flow rate in terms of pressure ratio, area ratio and Mach number, Working charts and gas tables, Application of Isentropic flow	12



3	Flow with normal shock waves: Development of a shock wave, Rarefaction wave, The governing equations, Prandtl-Meyer equation, Mach number downstream of the normal shock wave, Static pressure ratio across the shock, Temperature ratio across the shock, Density ratio across the shock (Rankine Hugoniot equations), Stagnation pressure ratio across the shock, Change in entropy across the shock, Strength of shock wave, Determination of Mach number of supersonic flow.	12
4	Flow in a constant area duct with friction: The Fanno curves, Fanno flow equations, Solution of Fanno flow equations, Variation of flow properties, Variation of mach number with duct length, Isothermal flow with friction	7
5	Flow in a constant area duct with heat transfer: The Rayleigh line, Fundamental equations, Rayleigh flow relations, Variation of flow properties, Maximum heat transfer	7
Total		45

List of Practicals / Tutorials:

1	To study about review of fundamentals: concept from Fluid Mechanics, Thermodynamics relations.
2	Study about fundamentals of compressible flow.
3	Study about one dimensional isentropic flow.
4	Study about normal shock wave.
5	Study about flow in constant area duct with friction (Fanno flow).
6	Study about flow in constant area duct with heat transfer (Rayleigh flow).
7	To study different type of flows and develop a gas table.
8	To study characteristics of real nozzle.
9	Study the effect of angle of attack on Lift and drag force.
10	Investigate on recent development and advances in rarefied gas Dynamics.

Reference Books:

1	Fundamental of Compressible flow, S. M. Yahya, New age international Publication, Delhi
2	Fundamentals of compressible fluid dynamics- P. Balachandran, PHI Learning, New Delhi
3	The dynamics and thermodynamics of Compressible fluid low Volume-I, Ascher H. Shapiro, the Ronald Press Company, New York.
4	Gas Dynamics, E. Rathakrishnan, PHI Learning Pvt. Ltd.
5	Modern Compressible Flow: With Historical Perspective, John D. Anderson, McGraw-Hill Higher Education
6	Gas Dynamics and Jet Propulsion- P. Murugaperumal, Scitech Publication, Chennai.

Supplementary learning Material:

1	NPTEL resources
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Pedagogy:

- Direct classroom teaching
- Audio Visual presentations/demonstrations
- Assignments/Quiz
- Continuous assessment
- Interactive methods
- Seminar/Poster Presentation

Internal Evaluation:

The internal evaluation comprised of written exam (40% weightage) along with combination of various components such as Certification courses, Assignments, Mini Project, Simulation, Model making, Case study, Group activity, Seminar, Poster Presentation, Unit test, Quiz, Class Participation, Attendance, Achievements etc. where individual component weightage should not exceed 20%.

Suggested Specification table with Marks (Theory) (Revised Bloom's Taxonomy):

Distribution of Theory Marks in %						R: Remembering; U: Understanding; A: Applying; N: Analyzing; E: Evaluating; C: Creating
R	U	A	N	E	C	
10%	20%	25%	25%	15%	5%	

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Course Outcomes (CO):

Sr.	Course Outcome Statements	%weightage
CO-1	Apply governing equations to practical problems involving compressible fluid flow.	30
CO-2	Analyze compressible flow through variable area duct critically.	25
CO-3	Analyze compressible flow having Normal shock by using different relations.	20
CO-4	Apply governing equations to compressible flow through constant area duct with friction and flow through constant area duct with heat transfer.	25

Curriculum Revision:

Version:	2
Drafted on (Month-Year):	June-2022
Last Reviewed on (Month-Year):	--
Next Review on (Month-Year):	June-2025