



**SARVAJANIK UNIVERSITY**  
Sarvajnik College of Engineering and Technology  
Bachelor of Technology



**Mechanical Engineering Department**

**B. Tech. Semester VII**

**Course Name:** Gas Dynamics **Subject Code:** BTME14715  
**Type of course:** Professional Elective Course  
**Prerequisite:** Fluid Mechanics  
**Rationale:** The course is design to provide concept of incompressible and compressible fluid flow under various flow conditions and to understand shock phenomenon analytically.

**Teaching and Examination Scheme:**

TEACHING SCHEME				Theory Marks			Practical Marks		Total
L	T	P	C	TEE	CA1	CA2	TEP	CA3	100
3	0	0	3	60	25	15	--	--	

**CA1:** Continuous Assessment (assignments/projects/open book tests/closed book tests **CA2:** Sincerity in attending classes/class tests/ timely submissions of assignments/self-learning attitude/solving advanced problems **TEE:** Term End Examination **TEP:** Term End Practical Exam (Performance and viva on practical skills learned in course) **CA3:** Regular submission of Lab work/Quality of work submitted/Active participation in lab sessions/viva on practical skills learned in course

**Content:**

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1.	<b>Fundamentals of Compressible Flow</b>  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.	<b>8</b>	<b>18%</b>



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Sr. No.	Topics	Teaching Hrs.	Module Weightage
2.	<p><b>One Dimensional Isentropic Flow:</b></p> <p>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.</p>	8	18%
3.	<p><b>Wind Tunnels:</b></p> <p>Requirements, classification and applications of different types of wind Tunnels.</p>	4	8%
4.	<p><b>Normal Shock Waves:</b></p> <p>Development of shock wave, Thickness of shock wave, governing equations, Strength of shock waves, Prandtl-Mayer relation, Rankine-Hugoniot relation, Mach number in the downstream of normal shock, variation of flow parameters across the normal shock, normal shock in Fanno and Rayleigh flows, impossibility of a rarefaction shock, supersonic diffusers, supersonic pitot tube.</p>	9	20%
5.	<p><b>Flow In Constant area Duct With Friction (Fanno flow):</b></p> <p>Fanno curve and Fanno flow equations, solution of Fanno flow equations, variation of flow properties, variation of Mach no. with duct length, isothermal flow in constant area duct with friction, tables and charts for Fanno flow, Experimental friction coefficients.</p>	8	18%
6.	<p><b>Flow in Constant Area Duct With Heat Transfer (Rayleigh Flow):</b></p> <p>Simple heating relation of a perfect gas, Rayleigh curve and Rayleigh flow equations, variations of flow properties, maximum heat transfer, tables and charts for Rayleigh flow.</p>	8	18%



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**Percentage Distribution of Marks as per Bloom's Taxonomy (Theory/Practical):**

<b>Percentage Distribution of Marks</b>					
<b>R Level</b>	<b>U Level</b>	<b>A Level</b>	<b>N Level</b>	<b>E Level</b>	<b>C Level</b>
<b>15</b>	<b>20</b>	<b>20</b>	<b>20</b>	<b>15</b>	<b>10</b>

**Legends: R:** Remembrance, **U:** Understanding; **A:** Application, **N:** Analyze, **E:** Evaluate **C:** Create and above Levels

**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.

**Reference Text Books:**

<b>Sr. No.</b>	<b>Title of book /article</b>	<b>Author(s)</b>	<b>Publisher and details like ISBN</b>	<b>Year of publication</b>	<b>Publication Edition</b>
1	Fundamental of Compressible flow	S. M. Yahya	New Age International Publication, New Delhi	2018	6th
2	Fundamentals of Gas Dynamics	Robert D. Zucker, Oscar Biblarz	Wiley	2019	3rd
3	Fundamentals of Gas Dynamics	Mrinal Kaushik	Springer Link	2022	1st
4	Gas Dynamics	E. Rathakrishnan	PHI Learning Pvt. Ltd.	2014	5th
5	Modern Compressible Flow: With Historical Perspective	John D. Anderson	McGraw-Hill Higher Education.	2017	3rd



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**Course Outcome:**

Sr. No.	CO Statement After learning this subject, students will be able to	Marks % weightage
CO-1	Identify practical problems involving compressible fluid flow and solving with the use of governing equations.	20%
CO-2	Determine the flow parameters for isentropic flow in steady flow devices.	30%
CO-3	Discuss the effect of normal shock waves in compressible fluid flow.	20%
CO-4	Analyze the effect of friction on compressible flow through various cross section with and without heat generation.	20%
CO-5	Solve the compressible flow through variable area duct critically.	10%

**Mapping of (CO's) with Program Outcomes (PO's) and Program Specific Outcomes (PSO's):**

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO-1	1	1	0	0	1	1	0	0	0	1	0	1	2	2	1
CO-2	2	1	0	0	1	1	0	0	0	1	0	1	2	2	1
CO-3	2	2	0	0	1	1	0	0	0	1	0	1	2	2	1
CO-4	2	2	0	0	1	1	0	0	0	1	0	1	2	2	1
CO-5	2	2	1	2	0	0	0	0	0	0	0	0	2	1	1
Rationale*	9	8	1	2	4	4	0	0	0	4	0	4	10	9	5

**Rationale - Mapping of CO's with PO's and CO's with PSO's:**

This course will develop engineering knowledge in integration with various condition of fluid flow. The objective of this course is to study the basic equations of compressible flow, isentropic relationships, and normal and oblique shock waves, Fanno line; applications to nozzles, diffusers.



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This course highly maps with PO and PSO 1. It states that the course will develop. This Course also focuses on Engineering knowledge, Problem analysis, Design / development of solutions, Conduct investigations of complex problems, Modern tool usage, The engineer and society, Environment and sustainability, Ethics, Individual and teamwork, Communication, Project management and finance, Life-long learning.

**Assignments to be given as per the requirement of the course.**

**List of open learning website:**

1. <https://nptel.ac.in/courses/112103021>