

**GUJARAT TECHNOLOGICAL UNIVERSITY**  
**BRANCH NAME: Mechanical Engineering**  
**SUBJECT NAME: Gas Dynamics**  
**SUBJECT CODE: 2171914**  
**B.E. 7<sup>th</sup> SEMESTER**

**Type of course:** Fundamental

**Prerequisite:** Fluid Mechanics

**Rationale:**

**Teaching and Examination Scheme:**

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P		Theory Marks			Practical Marks			
			ESE (E)	PA (M)		ESE (V)		PA (I)		
				PA	ALA	ESE	OEP			
3	2	0	5	70	20	10	30	0	20	150

L- Lectures; T- Tutorial/Teacher Guided Student Activity; P- Practical; C- Credit; ESE- End Semester Examination; PA- Progressive Assessment; OEP-Open Ended problem; AL-Active learning;

**Content:**

Sr. No.	Content	Total Hrs	% 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.	8	19
2	<b>One Dimensional Isentropic flow:</b> 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	10	24
3	<b>Normal shock Waves:</b> 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	9	22
4	<b>Flow in constant area duct with friction (Fanno flow):</b> 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,	8	19

5	<b>Flow in constant area duct with heat transfer (Rayleigh flow):</b> 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.	7	16
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**Suggested Specification table with Marks (Theory):**

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
7	10	17	18	11	7

**Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)**

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 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. Gas Dynamics and Jet Propulsion- P. Murugaperumal, Scitech Publication, Chennai.
6. Modern Compressible Flow: With Historical Perspective, John D. Anderson, McGraw-Hill Higher Education

**Course Outcome:**

After learning the course the students should be able to:

- Understand the basic concept of Gas Dynamics.
- Understand Behavior of Gas under various conditions.
- Use the Gas tables
- Understand basics of compressible flow
- Correlate fundamentals of Gas Dynamics with various mechanical systems

**List of Experiments:**

**Design based Problems (DP)/Open Ended Problem:**

**Major Equipment:**

**List of Open Source Software/learning website:**

1. <http://nptel.ac.in/courses/112103021/>
2. <http://freevideolectures.com>
3. [www.learnerstv.com](http://www.learnerstv.com)

**ACTIVE LEARNING ASSIGNMENTS:** Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.