FACULTY OF ENGINEERING & TECHNOLOGY

First Year Master of Engineering

Semester II

Course Code: **102440204**

Course Title: **Advance Gas Dynamics**

Type of Course: Program Elective III

Course Objectives: The course is prepared to provide the detailed understanding of laws and principles of Gas dynamics.

Teaching & Examination Scheme:

Contact hours per week			Course Credits	Examination Marks (Maximum / Passing)				
				Internal		External		Total
Lecture	Tutorial	Practical		Theory	J/V/P*	Theory	J/V/P*	
3	0	2	4	40/16	20/08	60/24	30 /12	150/60

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

Detailed Syllabus:

Sr.	Contents	Hours
1	FUNDAMENTALS OF COMPRESSIBLE FLOW Continuity, momentum and energy equation, control volume, sonic velocity, Mach number and its significance, Mach waves, Mach cone and Mach angle, Von Karman rules of supersonic flow, 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.	8
2	ISENTROPIC FLOW WITH VARIABLE AREA One dimensional isentropic flow in ducts of varying cross-section- nozzles and diffusers, mass flow rate in nozzles, critical properties and choking, area ratio as function of Mach number, Impulse function, effect of back pressure variation of convergent and convergent divergent nozzles, non-dimensional mass flow rate in terms of pressure ratio, area ratio and Mach number, flow through diffusers, use of gas tables.	10
3	FLOW IN CONSTANT AREA DUCT WITH FRICTION (FANNO FLOW) 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	7
4	FLOW IN CONSTANT AREA DUCT WITH HEAT TRANSFER (RAYLEIGH FLOW) Rayleigh curve and Rayleigh flow equations, variations of flow properties, maximum heat transfer, tables and charts for Rayleigh flow.	6

5	NORMAL SHOCK Development of shock wave, governing equations, Prandtl-Mayer relation, Rankine-Hugoniot relation, strength of shock wave, 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.	**6**
6	WIND TUNNEL Types of wind tunnels, special problems of testing in subsonic, transonic, supersonic and hypersonic speed regions – Layouts – sizing and design parameter, calibration of wind tunnels.	**2**
7	Click or tap here to enter text.	Click
8	Click or tap here to enter text.	Click
9	Click or tap here to enter text.	Click
10	Click or tap here to enter text.	Click
11	Click or tap here to enter text.	Click
12	Click or tap here to enter text.	Click
13	Click or tap here to enter text.	Click
14	Click or tap here to enter text.	Click
15	Click or tap here to enter text.	Click

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

Distribution of Theory Marks						R: Remembering; U: Understanding; A: Application, N: Analyze; E: Evaluate; C: Create
R	U	A	N	E	C	
10%	25%	20%	20%	20%	05%	

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	Gas Turbine Theory by Cohen & Rogers
2	Principle of Jet Propulsion and Gas Turbine by Zucrow M J, John Wiley & Sons
3	Rocket Propulsion Elements by George P. Sutton, Wiley
4	Rocket propulsion – Bevere
5	Jet propulsion – Nicholas Cumpst
6	Aircraft and Missile Propulsion - Zucrow N.J., John Wiley and Sons Inc, New York
7	Fundamentals of Compressible Flow by S. M.Yahya, New Age International Pvt Ltd
8	Gas Turbines and Propulsive Systems by Khajuria P. R, Dhanpat Rai Publishing Co Pvt Ltd
9	Click or tap here to enter text.
10	Click or tap here to enter text.

Course Outcomes (CO):

Sr.	Course Outcome Statements	%weightage
CO-1	Understand the basic concept of Gas Dynamics.	25
CO-2	Understand Behaviour of Gas under various conditions.	15
CO-3	Use the Gas tables	20
CO-4	Understand basics of compressible flow	20
CO-5	Correlate fundamentals of Gas Dynamics with various mechanical systems	20
CO-6	Click or tap here to enter text.	Click
CO-7	Click or tap here to enter text.	Click
CO-8	Click or tap here to enter text.	Click
CO-9	Click or tap here to enter text.	Click
CO-10	Click or tap here to enter text.	Click

Opp. Shastri Maidan, Beside BVM College, Vallabh Vidyanagar, Dist: Anand, Gujarat - 388120

(O): 02692-238001 | Email: adminoffice@cvmu.edu.in | www.cvmu.edu.in

List of Practicals / Tutorials:

Click or tap here to enter text.

1	Study of fundamentals of compressible flow -
2	Study of fundamentals of compressible flow – II
3	To study One Dimensional Isentropic flow
4	Study of Normal shock Waves
5	Study of Flow in constant area duct with friction (Fanno flow)
6	To study Flow in constant area duct with heat transfer (Rayleigh flow)
7	Develop a gas table (Isentropic flow, Normal shocks, Rayleigh flow, Fanno flow) for different γ values
8	A case study: Performance 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
11	Click or tap here to enter text.
12	Click or tap here to enter text.
13	Click or tap here to enter text.
14	Click or tap here to enter text.
15	Click or tap here to enter text.

Supplementary learning Material:

1	Click or tap here to enter text.
2	Click or tap here to enter text.
3	Click or tap here to enter text.
4	Click or tap here to enter text.
5	Click or tap here to enter text.

Curriculum Revision:

Version:	1
Drafted on (Month-Year):	Apr-20
Last Reviewed on (Month-Year):	Jul-20
Next Review on (Month-Year):	Apr-22