B.E Semester: VII

Mechanical Engineering

Subject Name: Gas Dynamics

A. Course Objective

- To present a problem oriented in depth knowledge of Gas Dynamics.
- To address the underlying concepts, methods and application of gas dynamics.

B. Teaching / Examination Scheme

SUBJECT		Teaching Scheme				Total Credit	Evaluation Scheme					Total Marks
		L	T	P	Total		THEORY		IE	CIA	PR. / VIVO	
CODE	NAME	Hrs	Hrs	Hrs	Hrs		Hrs	Marks	Marks	Marks	Marks	
ME706-C	Gas Dynamics	4	0	0	4	4	3	70	30	20	0	120

C. Detailed Syllabus

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.

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.

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.

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.

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. Wind tunnel:
Types of wind tunnels - sub sonic wind tunnel, supersonic wind tunnel, projectile obstruction and shadow graph technique

D. Lesson planning

SR.NO	DATE/WEEK	UNIT NO	%WEIGHTAGE	TOPIC NO
1	1^{ST}, 2^{ND}, 3^{RD}	1	20	1
2	4^{TH},5^{TH}, 6^{TH}	2	20	2
3	7^{TH},8^{TH}, 9^{TH}	3, 4	20	3, 4
4	10^{TH},11^{TH}, 12^{TH}	5	20	5
5	13^{TH},14^{TH}, 15^{TH}	6	20	6

E. Instructional Method & Pedagogy

1. At the start of course, the course delivery pattern , prerequisite of the subject will be discussed
2. Lecture may be conducted with the aid of multi-media projector, black board, OHP etc. & equal weightage should be given to all topics while teaching and conduction of all examinations.
3. Attendance is compulsory in lectures and laboratory, which may carries five marks in overall evaluation.
4. One/Two internal Pr. / Vivo exams may be conducted and total/average/best of the same may be converted to equivalent of 30 marks as a part of internal theory evaluation.
5. Assignment based on course content will be given to the student for each unit/topic and will be evaluated at regular interval. It may carry an importance of ten marks in the overall internal evaluation.
6. Surprise tests/Quizzes/Seminar/Tutorial may be conducted and having share of five marks in the overall internal evaluation.

F. Students Learning Outcomes

- The student can identify different areas of Gas Dynamics.
- Can find the applications of all the areas in industry.

G. Recommended Study Materials

1. Dynamics of compressible flow – S.M. Yahya, New Age Publishers, Delhi

2. Fundamentals of compressible fluid dynamics- P. Balachandran, PHI Learning, New Delhi.

3. Gas Dynamics and Jet Propulsion- P. Murugaperumal, Scitech Publication, Chennai.

4. Gas Dynamics and Jet Propulsion- B.L. Singhal, Macmillan Publishers India Ltd, New Delhi.

5. Gas Turbines and Jet Propulsion – Nirali Prakshan, Pune.

6. Gas turbine theory and jet propulsion – J.K. Jain, Khanna publishers, New Delhi.

7. Gas Dynamics – James John and Theo Keith, Pearson, New Delhi