Course Type	Course Code	Name of Course	L	T	P	Credits
DE	NMED509	Gas Dynamics	3	0	0	3

Course Objectives

Prerequisite: Knowledge in basic fluid mechanics is essential

- The aim of the course is to lay out the basic concepts and results for the compressible flow of gases.
- Students can apply the principles of gas dynamics for the design of high speed vehicles, such as rockets, missiles and high speed aircraft.

Learning Outcomes

Upon successful completion of this course, students will:

- have a broad understanding of the basic concepts of gas dynamics.
- have a thorough understanding of Mach waves, shock waves and their relations.
- be able to apply the principles of gas dynamics for predicting the aerodynamic characteristics of the in high speed vehicles.

Unit No.	Topics to be Covered Lecture	Lecture Hours	Learning Outcomes
1	Review of Fundamentals: Concepts from Fluid Mechanics, Compressibility Thermodynamic concepts, Conservation equations, Stagnation state	4L	To understand the basic concepts and elements of compressible flow
2	Compressible flow: Concept of Waves in fluid, Mach waves, Compression waves, Expansion fans, Differential equations for 1D flow	4L	To understand the concepts of Mach waves, Compression waves, Expansion fans and differential equations for 1D flow
3	Basic Flow features: Isentropic flow, Shock waves, Stationary and Moving Shocks, Oblique Shocks, Bow Shocks, Expansion Fans, Normal Shock Concept, Normal Shock relations, Moving normal shocks Concept and theory, Oblique Shock relations, Property variations	7L	To understand the concepts of a shock wave, stationary and moving, Normal and oblique shocks, Normal/Oblique shock relations
4	Detached Shocks, Shock Reflections, Flow around bodies, Crocco's theorem, Cone flows, Shock expansion theory	10L	To understand the concepts of detached shocks, shock reflections, Cone flows and shock expansion theory

5	Quasi-1D flow with area variations, Geometric Choking, Convergent Nozzles, CD Nozzles, Exit vs Stagnation pressure variation, shock wave reflections, Jet flows, Under expanded and over-expanded jet flows, Flow with Friction, Friction choking, Flow with heat addition, Thermal choking	10L	To understand the concepts of QUASI-1D flows, Under expanded and over-expanded jet flows, Flows with friction and Flows with heat transfer
6	Prandtl Meyer Function, Supersonic wind tunnel, Shock Tube, Shock tunnel, Flow visualization, Basics of hypersonic flow	7L	To understand the concepts of supersonic wind tunnel, Shock Tube and Shock tunnel
	Total	42 hrs	

Text books

1. Liepmann, H. W. and Roshko, A., Elements of Gas Dynamics, Dover Publications Inc., 2002.

2. John D. Anderson, Modern Compressible Flow: With Historical Perspectives, 3rd Edition, 2004.

Reference books

1. Oosthuizen, P. H. and Carscallen, W. E., Compressible Fluid Flow, McGraw-Hill international Edition, Singapore, 1st Edition, 2003.

2. Babu, V., Fundamentals of Gas Dynamics, Wiley-Blackwell, 2nd Edition, 2014.

3. Chapman A. J. and Walker W. F., Introductory Gas Dynamics, Holt, Reinhart and Winston, Inc., NY, USA, 1st Edition, 1971.

4. S. M. Yahya, Fundamentals of Compressible Flow with Aircraft and Rocket Propulsion, New Age International, 2018.