Advanced Gas Dynamics

Swayam Prabha Course Code: M64

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COURSE OUTLINE	This course introduces the concepts of the primary differences between an incompressible flow and compressible flow. It draws the connection between compressible flow and speed of sound, Mach Number and thermodynamics. It then builds on the governing equations to derive the commonly known equations and tackles both 2D and 3D problems. The physical concept of shocks and the resulting changes in the thermodynamic properties of a fluid form a major part of this course. The course concentrates primarily on the understanding of the physical concepts of compressible flow and keeps reference to various numerical methods for solving the governing equations to a minimum.

COURSE DETAILS

S. No	Module ID/ Lecture ID	Lecture Title/Topic
1.	L1	Introduction to Gas Dynamics & Review of Basic Thermodynamics
2.	L2	Review of Basic Thermodynamics Continued
3.	L3	An introduction to Normal Shocks
4.	L4	The Mach Number and Compressible Flow
5.	L5	The relation of physical properties across a normal shock
6.	L6	Normal Shock in a duct: Throat and Reservoir conditions
7.	L7	Example Problems in Normal Shocks
8.	L8	An introduction to Oblique Shocks

9.	**L9**	The relation of physical properties across an oblique shock
10.	**L10**	Example Problems in Oblique Shocks
11.	**L11**	Pressure - Deflection relationship of Shocks
12.	**L12**	An introduction to Expansion waves
13.	**L13**	Area - Mach Relationship
14.	**L14**	Unsteady Shock Waves: The Shock Tube
15.	**L15**	The Shock Tube: Propagating Normal Shock and its reflection from end wall
16.	**L16**	A review of wave propagation
17.	**L17**	Wave propagation: Small Perturbation Theory
18.	**L18**	Finite Wave Theory: An introduction to the Method of Characteristics
19.	**L19**	The Shock Tube: Propagating Expansion Fan
20.	**L20**	The Method of Characteristics
21.	**L21**	Application of The Method of Characteristics: Design of a minimum length nozzle
22.	**L22**	Application of The Method of Characteristics: Flow through a diverging channel
23.	**L23**	Flow over a Wavy wall: Formulation using Perturbation Theory
24.	**L24**	Subsonic Flow over a Wavy wall
25.	**L25**	Supersonic Flow over a Wavy wall - I
26.	**L26**	Supersonic Flow past a 3D Cone: Axisymmetric/Quasi 2D Flow
27.	**L27**	Quasi 2D Flow - I
28.	**L28**	Quasi 2D Flow - II
29.	**L29**	Similarity Rules and Transformed Coordinate System
30.	**L30**	Critical Mach Number and Thin Airfoil Theory
31.	**L31**	Example Problem using Thin Airfoil Theory
32.	**L32**	Example Problems – I
33.	**L33**	Example Problems – II

34.	**L34**	Example Problems - III
35.	**L35**	Supersonic Flow past a 3D Cone at an angle of attack
36.	**L36**	Supersonic Flow past a 3D Cone at an angle of attack: Flow Visualization - I
37.	**L37**	Supersonic Flow past a 3D Cone at an angle of attack: Flow Visualization - II
38.	**L38**	Supersonic Flow past a 3D Cone at an angle of attack: Governing Equations
39.	**L39**	Supersonic Flow past a 3D Cone at an angle of attack: Numerical Procedure
40.	**L40**	Supersonic Flow past a 3D Bluff Body at an angle of attack

List of reference material/ books:

1. Elements of Gas Dynamics, H. W. Liepmann and A. Roshko

2. Modern Compressible Flow, John D. Anderson, Jr.

Name and contact details of two referees for the course: