WIND TUNNEL TECHNIQUES

PROFESSIONAL ELECTIVE - III

VII Semester

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIE	SEE	Total
A5AE45	PCC	3	0	0	3	30	70	100

COURSE OBJECTIVES:

The course should enable the students to:

1. To interpret the basic concepts of measurement of forces and moments on models during the wind tunnel testing.
2. To understand the application of various types of wind tunnels.
3. To learn the basic measurement procedure involving wind tunnel testing

UNIT-I WIND TUNNELS

Wind Tunnel, layouts and nomenclature, Types of Wind Tunnels – continuous and intermittent -closed circuit and open circuit - closed jet and open jet test section – application.
Special purpose tunnels - Smoke Tunnels – Water Tunnels – Spin tunnel, automobile wind tunnel and environmental wind tunnel Important parameters of flow similarity. types of flow similarities for compressible and incompressible flows Model power consideration.

UNIT-II FLOW VISUALIZATION TECHNIQUES

Path – Streak – Stream and Timelines; Techniques: Smoke, Tuft, Streaks, Surface oil flow. Pressure measurements: Manometers – U-Tube, Inclined and Precession. Bourdon Gauge and Pressure Transducer – Strain Gauge, Semi conductor – Absolute and Differential. Velocity Measurements: Pivot Tube – Static and Total. Calibration of test section: Test section flow calibration and Boundary Layers

UNIT-III MEASUREMENTS OF FORCES AND MOMENTS

Forces, moments and Reference Frames – Balances – Internal and External - Requirements and Specifications – Fundamentals of Model Installations. Boundary correction, types of blockages: ~~2-D..~~

UNIT-IV HIGH SPEED WIND TUNNELS

Supersonic Wind Tunnels and - Classification - Runtime - Compressors - Charging Times - nozzle Mass Flows - Starting Loads - Model Size – Calibration.
Hypersonic Wind Tunnels: Classification – Runtime – Vacuum Tanks – Vacuum pumps – Evacuation Times. Shock Tube: Driver – driven – Vacuum Pumps – Diaphragm

UNIT-V HIGH SPEED FLOW VISUALIZATIONS AND MEASUREMENTS

Schlieren and Shadow Graph – Pressure sensitive Paints – Temperature sensitive Paints – Force Measurements – Strain Gauge Balances – Pressure Measurements
Case study – Experimental analysis of flow over a bullet.

Text Books:

1. Rae, W.H. and Pope, A. —Low Speed Wind Tunnel Testingǁ, John Wiley Publication, 1999
2. Pope, A., and Goin, L., —High Speed wind Tunnel Testingǁ, John Wiley Publication , 1999
3. Pope, J B Barlow —low speed wind tunnel testing — 3 edition j.w publication

Reference Books:

1. John D. Anderson, Jr., "Fundamentals of Aerodynamics", Third edition, McGraw-Hillpublications, 2001
2. E L Houghton and PW Carpenter, "Aerodynamics for Engineering students", Fourth edition,Edward Arnold publications, 1993.
3. L.M Miline Thomson, —Theoretical Aerodynamicsǁ, 1996 McGraw-Hill,New Delhi.
4. R. Halmshaw (1991), Non-Destructive Testing, 2nd edition, Edward Arnold, New York

COURSE OUTCOMES:

At the end of the course the student should be able to:

1. Ability to understand basics of aerodynamics and to identify the type of wind tunnel
2. Ability to develop and understand flow visualization techniques over model
3. Ability to understand concepts of low speed and high speed wind tunnels
4. Ability to understand measurement and balancing of loads on model
5. Ability to understand the different types of equipment's for measuring pressure and velocity