

## **AE8012 WIND TUNNEL TECHNIQUES**

### DETAILED SYLLABUS

#### **OBJECTIVE**

- The students are exposed to various types and techniques of Aerodynamic data generation on aerospace vehicle configurations in the aerospace industry.

#### **UNIT I LOW SPEED WIND TUNNELS**

Classification –non-dimensional numbers-types of similarities - Layout of open circuit and closed-circuit subsonic wind tunnels – design parameters-energy ratio - HP calculations - Calibration methods.

#### **UNIT II HIGH SPEED WIND TUNNELS**

Blow down, in draft and induction tunnel layouts and their design features -Transonic, and supersonic tunnels- peculiar features of these tunnels and operational difficulties - sample design calculations and calibration methods.

#### **UNIT III SPECIAL WIND TUNNEL TECHNIQUES**

Types of Special Wind Tunnels – Hypersonic, Gun and Shock Tunnels – Design features and calibration methods- Intake tests – store carriage and separation tests - wind tunnel model design for these tests

#### **UNIT IV WIND TUNNEL INSTRUMENTATION**

Instrumentation and sensors required for both steady and unsteady measurements – Force measurements using three component and six component balances – calibration of measuring instruments – error estimation and uncertainty analysis.

#### **UNIT V FLOW VISUALIZATION and NON-INTRUSIVE FLOW DIAGNOSTICS**

Smoke and Tuft grid techniques – Dye injection special techniques – Oil flow visualization and PSP techniques - Optical methods of flow visualization – PIV and Laser Doppler techniques – Image processing and data deduction

#### **TEXT BOOKS:**

1. NAL-UNI Lecture Series 12:" Experimental Aerodynamics", NAL SP 98 01 April 1998
2. Rae, W.H. and Pope, A., "Low Speed Wind Tunnel Testing", John Wiley Publication, 1984.

#### **REFERENCES:**

1. Bradsaw "Experimental Fluid Mechanics".
2. Lecture course on Advanced Flow diagnostic techniques 17-19 September 2008 NAL, Bangalore
3. Pope, A., and Goin, L., "High Speed Wind Tunnel Testing", John Wiley, 1985.
4. Radhakrishnan, E., "Instrumentation, Measurements, and Experiments in Fluids," CRC Press –Taylor & Francis, 2007.