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# INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

B.Tech VI Semester End Examinations (Regular) - May, 2019

**Regulation: IARE – R16**

## EXPERIMENTAL AERODYNAMICS

**Time: 3 Hours**

**(AE)**

**Max Marks: 70**

**Answer ONE Question from each Unit**

**All Questions Carry Equal Marks**

**All parts of the question must be answered in one place only**

### UNIT – I

1. (a) Explain low and high-speed wind tunnels layout, principles and explain the following important components: the effuser, the working or test-section, the diffuser, and the driving unit. [7M]
- (b) The model of a boat is made to a scale 1:60. The model boat has a wave resistance of 0.025 N while operating in water at a velocity of 1 m/s. Determine the corresponding the wave resistance of the prototype. Find also the power required for the prototype. What velocity does this test represent in the prototype? [7M]
2. (a) Mention the importance of sizing and design parameters? Discuss about various types of special tunnels and their usage advantages. [7M]
- (b) An open circuit subsonic wind tunnel of test-section 1.2 m X 0.9 m is run by a 110 kW motor. If the test-section speed is 90 m/s, calculate the energy ratio of the tunnel. Also, find the total loss in the tunnel in terms of testsection kinetic energy. Take the air density as the standard sea level value. [7M]

### UNIT – II

3. (a) Identify the methods used to measure flow angularities and the instruments used to measure them? [7M]
- (b) Determine the minimum possible diffuser contraction ratio and the power required for a two-stage compressor to run a closed-circuit supersonic tunnel at  $M = 2.2$ . The efficiency of the compressor is 85 percent,  $p_{01} = 4 \text{ atm}$ ,  $T_0 = 330\text{K}$  and  $ATS = 0.04\text{m}^2$  [7M]
4. (a) Summarize the flow characteristics in the wind tunnel by using calibration of wind tunnel Discuss about the power losses in wind tunnel and derive the expression for losses [7M]
- (b) Why a drive system is required in a wind tunnel? Why Can't the wind tunnel have a sustained flow with just a convergent- test section- diffuser arrangement? [7M]

### UNIT – III

5. (a) Discuss the method of yoke balance wind tunnel with neat sketch along with equations [7M]
- (b) With a neat illustration, explain the objective of calibration of a wind tunnel. In what way the calibration procedure for a supersonic tunnel different from that of a subsonic wind tunnel. [7M]

6. (a) Highlight the importance of wind tunnel balance? Mention the various types? [7M]  
(b) Explain the purpose of heater in the settling chamber and second throat in the supersonic wind tunnel. [7M]

#### UNIT – IV

7. (a) What is the basic principle behind, laser doppler anemometry? What are its limitations? [7M]  
(b) Find the pressure that would be read by a mercury manometer connected to a static pressure tap located at the wall of a convergent nozzle where the flow Mach number is 0.8 and the nozzle is connected to a tank at a pressure of 3 atmospheres absolute (assume  $\gamma = 1.4$ , for the gas). [7M]
8. (a) Explain the total pressure measurements by incidents, Reynolds number and velocity gradient effects. [7M]  
(b) The U-type manometer measures total and static pressures of a high-speed flow as 535 mm Hg (suction) and 610 mm of mercury (suction) respectively. Determine the flow Mach number. [7M]

#### UNIT – V

9. (a) Distinguish between the working of schlieren and shadow graphs with their merits and demerits [7M]  
(b) Explain the phenomenon of separation of flow over a 2D wing with the help of liquid paraffin generated smoke wire technique with good sketches. What are its merits over kerosene-generated smoke? [7M]
10. (a) Explain flow visualization by dye in water-direct injection method. [7M]  
(b) What is the need of flow visualization techniques? Briefly explain the optical methods used for flow visualization. [7M]

