

# CBCS SCHEME

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15AE752

## Seventh Semester B.E. Degree Examination, Feb./Mar. 2022 Wind Tunnel Techniques

Time: 3 hrs.

Max. Marks: 80

*Note: Answer any FIVE full questions, choosing ONE full question from each module.*

### Module-1

- 1 a. The Resisting force  $R$  of a supersonic Aircraft depends on the following properties. It depends on length of the aircraft ' $l$ ', velocity ' $v$ ', dynamic viscosity ' $\mu$ ', density of air ' $\rho$ ' and bulk modulus of air ' $K$ '. Express the function for resisting force using Buckingham's  $\pi$ -theorem. (08 Marks)
- b. Write and explain about Geometric similarity, kinematic similarity and dynamic similarity. (08 Marks)

OR

- 2 a. Write and derive the expression for Reynold's number and Mach number. (08 Marks)
- b. The pressure drop in an aeroplane model of size  $1/50$  of its prototype is  $4\text{N/cm}^2$ . The model is tested in water. Find the corresponding pressure drop in prototype. Take  $\rho_{\text{air}} = 1.24 \text{ kg/m}^3$ , viscosity of water =  $0.01$  poise, viscosity of air =  $0.00018$  poise. (08 Marks)

### Module-2

- 3 a. Write and explain about types of High speed wind tunnels. Explain any two types with sketch. (08 Marks)
- b. Explain about problems of testing in supersonic and hypersonic tunnel. (08 Marks)

OR

- 4 a. Explain about following with neat sketch: i) Hotshot tunnel ii) Shock tunnel. (08 Marks)
- b. Explain types of low speed wind tunnel and also write differentiation between open and closed circuit wind tunnel. (08 Marks)

### Module-3

- 5 Briefly explain about calibration of subsonic and supersonic wind tunnel. (16 Marks)

OR

- 6 Explain about following with neat sketch:
- Hot-wire anemometer
  - Turbulence sphere
  - Yaw sphere
  - Pressure sphere.
- (16 Marks)

### Module-4

- 7 Explain about different methods of flow visualization techniques used for compressible flow. (16 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.  
2. Any revealing of identification, appeal to evaluator and /or equations written eg.  $42+8=50$ , will be treated as malpractice.

OR

- 8 Explain the following neat sketch: (03 Marks)
- a. Wire type balance (03 Marks)
  - b. Strut type balance (03 Marks)
  - c. Platform type balance (03 Marks)
  - d. Yoke type balance (04 Marks)
  - e. Strain-gauge balance.

**Module-5**

- 9 Design a supersonic wind tunnel for the test section size of  $1\text{m} \times 1\text{m}$  for the speed of Mach number 2 in the test section. Also calculate maximum mass flow rate through wind tunnel. Take runtime of wind tunnel as 4 seconds. Settling chamber exit area =  $2\text{m}^2$ , semi divergence and semi convergence angle of nozzle as  $7^\circ$  and  $3^\circ$  respectively. Assume tank volume as  $20\text{m}^3$ . (16 Marks)

OR

- 10 a. Determine the running time for a Mach 2 blow down tunnel with test section area  $300\text{mm} \times 300\text{mm}$ . The storage tank volume is  $20\text{m}^3$  and the pressure and temperature of air in the tank are 20atm and  $25^\circ\text{C}$  respectively. Take starting pressure ratio for Mach 2.0 as 3, the loss in pressure regulating valve to be 50% and polytropic index  $n = 1.0$ . Use isentropic relation for calculating ratio properties. (08 Marks)
- b. Explain about various pressure measurement techniques available today. (08 Marks)

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