Hall Ticket No | | | | | | | | | | |

Question Paper Code: AAEC36

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal-500043, Hyderabad

B.Tech VI SEMESTER END EXAMINATIONS (REGULAR) - JULY 2023
Regulation: UG-20
TECHNIQUES IN WIND TUNNEL TESTING

Time: 3 Hours **(AERONAUTICAL ENGINEERING)** **Max Marks: 70**

Answer ALL questions in Module I and II
Answer ONE out of two questions in Modules III, IV and V
All Questions Carry Equal Marks
All parts of the question must be answered in one place only

MODULE – I

1. (a) Explain similarity laws and obtain an expression for Reynolds number and Euler number from dimensional analysis. [BL: Understand| CO: 1|Marks: 7]

   (b) A ship is 300 m long moves in sea water, whose density is 1030 kg/m^3. A 1:100 model of this to be tested in a wind tunnel. The velocity of air in the wind tunnel around the model is 30 m/s and the resistance of the model is 60 N. Determine the velocity of ship in sea water and also the resistance of the ship in sea water. The density of air is given as $1.24kg/m^3$. Take the Kinematic viscosity of sea water and air as 0.012 stokes and 0.018 stokes respectively.
   [BL: Apply| CO: 1|Marks: 7]

MODULE – II

2. (a) 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?
   [BL: Understand| CO: 2|Marks: 7]

   (b) A subsonic open-circuit wind tunnel runs with a test section speed of 40 m/s. The temperature of the lab environment is 16^0C. If a turbulent sphere measures the turbulence factor TF of the tunnel as 1.2, determine the sphere diameter. Assume the test-section pressure as the standard sea level pressure. [BL: Apply| CO: 2|Marks: 7]

MODULE – III

3. (a) Summarize how force measurements are carried out using an internal strain gauge balance?
   [BL: Understand| CO: 3|Marks: 7]

   (b) What types of wind tunnel balances are used to ascertain forces and moments on an airplane model in a low speed wind tunnel? Hence describe the underlying principles of an external type wind tunnel balance for measuring lift, drag and pitching moments over a finite span wing.
   [BL: Apply| CO: 3|Marks: 7]

4. (a) How the strut-type balances are classified? Draw the schematic layout of a strut-type balances and illustrate its working principle. [BL: Understand| CO: 4|Marks: 7]

   (b) Sketch the basic layout of a platform balance. Explain the working of a platform balance. Write the forces and moments for the three legged type platform balance.
   [BL: Apply| CO: 4|Marks: 7]

MODULE – IV

5. (a) Demonstrate the measurement of pressure, velocity and temperature in a wind tunnel with the help of neat sketches. [BL: Understand| CO: 5|Marks: 7]

   (b) Enlist two equipment's and their working principles to calibrate the flow angularity in low speed subsonic wind tunnel. [BL: Apply| CO: 5|Marks: 7]

6. (a) Write short notes on measurements of turbulence level in a transonic wind tunnel. Explain the techniques used for turbulence measurements in a wind tunnel.

   [BL: Understand| CO: 5|Marks: 7]

   (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).

   [BL: Remember| CO: 5|Marks: 7]

MODULE – V

7. (a) With neat illustration explain the basic principles of Schelieren method of flow visualization. Mention the advantages and limitations of the method [BL: Understand| CO: 6|Marks: 7]

   (b) Illustrate 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? [BL: Analyze| CO: 6|Marks: 7]

8. (a) Discuss the smoke and tuft grid techniques used for flow visualization with necessary sketches.

   [BL: Understand| CO: 6|Marks: 7]

   (b) Explain the principle involved and discuss the merits and demerits for the following:

   i) Interferometry ii) Smoke list iii) Shadowgraphy [BL: Understand| CO: 6|Marks: 7]

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