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Question Paper Code : 71338

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2017.

Eighth Semester

Aeronautical Engineering

AE 6801 — WIND TUNNEL TECHNIQUES

(Regulations 2013)

Time : Three hours   Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define Froude's number.

2. Define kinematic similarity.

3. List some special purpose wind tunnels.

4. Differentiate open jet and open circuit wind tunnel.

5. What do you meant by horizontal buoyancy?

6. State the limitations of turbulence sphere.

7. State the principle behind Laser Doppler Anemometer.

8. What are the limitations of smoke flow visualization methods?

9. List any two methods used for unsteady force measurements.

10. What are light scaling and heavy scaling?

PART B — (5 × 16 = 80 marks)

11. (a)   The drag force on a submarine which is moving well below the free surface, is to be determined by a test on a model, which is scaled down to one-twentieth of the prototype. The test is to be carried in a water tunnel. The density and kinematic viscosity of the seawater are 1010 kg/m³ and 1.3×10^{-6} m²/s. The water in the tunnel has a density of 988 kg/m³ and a kinematic viscosity of 0.65×10^{-6} m²/s. If the speed of the prototype is 2.6 m/s, then determine the speed of the model and the ratio of the drag force in the prototype to the model.

Or

(b) An aircraft is to fly at an altitude of 9 km (where the temperature and pressure are −45°C and 30.2 kPa respectively) at 400 m/s. A 1:20 scale model is tested in a pressurized wind tunnel in which the air is at 15°C. For complete dynamic similarity what pressure and velocity should be used in the wind-tunnel?

12. (a) (i) With a neat sketch explain the operation of closed circuit continuous supersonic tunnel. Discuss its advantages and disadvantages. (8)

   (ii) Explain the purpose of second throat in supersonic wind tunnels. (8)

Or

(b) (i) Draw a typical hypersonic tunnel circuit and explain the operation. Discuss the special problems associated with it. (10)

   (ii) Discuss briefly about the losses in subsonic wind tunnels. (6)

13. (a) (i) Define Turbulence Factor. Explain any two methods used to determine the level of turbulence in subsonic tunnels. (8)

   (ii) How do you estimate flow angularity in a wind tunnel test section? Explain any one method with neat sketch. (8)

Or

(b) A supersonic wind tunnel with test section Mach number of 3 is to be designed. Determine the amount of total pressure to be provided by the reservoir for the following cases.

   (i) The nozzle exhausts directly to the atmosphere. (4)

   (ii) Add a constant area duct to the nozzle exit and then exhaust the duct to the atmosphere. (4)

   (iii) Add a divergent duct behind the constant area duct and then exhaust it to the atmosphere. (4)

   (iv) Explain the physical reasons behind the above three cases. (4)

14. (a) Explain in detail about Schlieren and Interferometer methods for high speed flow visualization with neat sketches. Discuss their relative advantages and disadvantages.

Or

(b) Explain in detail the working of any one type of pressure transducer with neat circuit. What are the advantages of pressure transducers over other pressure measuring devices?

15. (a) Explain with neat sketches any two methods used for unsteady pressure measurements.

Or

(b) Explain in detail the scaled dynamic separation and point prediction methods used for studying store separation characteristics.

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