

Reg. No. :

Question Paper Code : 52540

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2019.

Eighth Semester

Aeronautical Engineering

AE 6801 — WIND TUNNEL TECHNIQUES

(Regulation 2013)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. State Buckingham's Theorem.
2. Write down the types of similarities.
3. Classify the types of wind tunnels.
4. What is the function of Effuser?
5. Define horizontal buoyancy.
6. What are the losses in supersonic wind tunnels?
7. Classify flow visualization.
8. What are the advantages of using Tufts?
9. Name the types of pressure transducers.
10. What is Monometer?

PART B — (5 × 13 = 65 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/m^3 and $1.3 \times 10^{-6} \text{ m}^2/\text{s}$. The water in the tunnel has a density of 988 kg/m^3 and a kinematic viscosity of $0.65 \times 10^{-6} \text{ m}^2/\text{s}$. 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. (13)

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? (13)

12. (a) (i) Advantages of open return wind tunnels (5)
(ii) Disadvantages of open return wind tunnels (8)

Or

- (b) (i) Advantages of closed return wind tunnels (7)
(ii) Disadvantages of closed return wind tunnels (6)

13. (a) (i) Explain wind tunnel boundary layers? (6)
(ii) Methods of smoke formation. (7)

Or

- (b) (i) Describe the calibration of supersonic tunnel. (4)
(ii) Determine the Mach Number in the calibration of a supersonic tunnel (9)

14. (a) Write short notes on:
(i) Flow transducers and flow imaging (7)
(ii) Spatial and temporal characterization of Transducers. (6)

Or

- (b) Explain the following:
(i) Locating points of separation (8)
(ii) Describe Off — surface visualisation (5)

15. (a) Explain the procedure involved in the unsteady pressure measurements over an airfoil draw the $C_{p_{mean}}$, $C_{p_{rms}}$ profiles over NACA 4412 airfoil at an angle of attack of 15 degrees. (13)

Or

- (b) Explain the low speed wind tunnel design procedure with empirical equations and draw the wind tunnel model. (13)

PART C — (1 × 15 = 15 marks)

16. (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. (7)

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. (3)