Register Number: ……..

B.E., DEGREE EXAMINATIONS: MAY/JUNE 2013

Sixth Semester

AERONAUTICAL ENGINEERING

AER117 : Wind Tunnel Techniques

Time: Three Hours **Maximum Marks: 100**

Answer all the Questions:-

PART A (10 x 1 = 10 Marks)

1. A dimensionless group formed with the variables ρ (density), ω angular velocity, μ dynamic viscosity, and D (characteristic diameter) is
   a) $\rho \omega \mu / D^2$ b) $\rho \omega D^2 / \mu$
   c) $\rho \omega \mu D^2$ d) $\rho \omega \mu D$
2. Froude number is the ratio between
   a) Inertia force / Viscous force b) Pressure force / Viscous force
   c) Inertia force / Gravity force d) Pressure force / Gravity force
3. Fan advance ratio is
   a) $V/ 2\pi nr$ b) $2\pi V/ nr$
   c) $2\pi r / Vn$ d) $2\pi n / Vr$
4. In supersonic wind tunnel, area of first throat and second throat must be
   a) $A_1^* > A_2^*$ b) $A_1^* = A_2*$
   c) $A_1^* < A_2^*$ d) none of these
5. The flow angularity in a supersonic tunnel is usually determined by using
   a) Wedge yaw meter b) Pitot tube
   c) Hot wire anemometer d) Manometer.
6. The value of theoretical Reynolds number for a sphere is
   a) 38500 b) 3850
   c) 13850 d) 385000
7. The wave length of light is
   a) $\lambda = C/f$ b) $\lambda C = f$
   c) $\lambda = Cf$ d) none of these
8. The shadowgraph visualization techniques depend on
   a) The variation of the value of density in the flow b) The first derivative of density with respect to spatial coordinate
   c) The second derivative of density with respect to spatial coordinate d) The third derivative of density with respect to spatial coordinate

9. The lowest possible stagnation pressure for induction type tunnel is

a) Atmospheric value b) 2 bar

c) 0.5 bar d) 0.25 bar

10. The maximum temperature achieved by gun tunnel is

a) 500 K b) 1000 K

c) 2000 K d) 200 K

PART B (10 x 2 = 20 Marks)

11. Define Euler number and Weber number?
12. What is meant by scale effect in wind tunnel?
13. How do you classify the high speed wind tunnels?
14. What is the importants of measuring the turbulence level in wind tunnels?
15. Define horizontal buoyancy
16. What are the parameters included in supersonic wind tunnel calibration?
17. What are main advantages of LDA?
18. Name some smoke production materials.
19. List out the advantages of blow down type wind tunnels.
20. Find the test section temperature for a hypersonic stream of air at Mach 7 with stagnation temperature at 700 K.

PART C (5 x 14 = 70 Marks)

21. a) Drag force F on a high speed aircraft depends on the velocity of flight V, the characteristic geometrical dimension of the aircraft L, the density ρ, viscosity μ and isentropic bulk modulus of elasticity E of ambient air, Using Buckingham's π theorem, find out the independent dimensionless quantities which describe the phenomenon of drag on the aircraft.

(OR)

b) Briefly discuss the different types of similarities with examples.

22. a) (i) Explain the effect of second throat in supersonic wind tunnel. (8)

(ii) Explain the basic components of subsonic wind tunnel. (6)

(OR)

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°C. If a turbulent sphere measures the turbulence factor of the tunnel as 1.2, determine the sphere diameter. Assume the test section pressure as the sea level pressure.

23. a) Explain in detail the calibration of a supersonic wind tunnel for Mach number determination and Reynolds number effect.

(OR)

b) Explain the effects of the boundary constraints in wind tunnel test section.

24. a) Explain the various type of wind tunnel balancing methods and explain any two methods.

(OR)

b) Discuss the methods of flow visualization and explain the shadowgraph system of flow visualization method.

25. a) Explain the operation, advantages and disadvantages of induction type tunnel with neat sketch.

(OR)

b) Explain about the operation and application of shock tube with neat sketch.

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