

Register Number.....

B.E. DEGREE EXAMINATIONS: APRIL/MAY 2012

Sixth Semester

AERONAUTICAL ENGINEERING

AER117: Wind Tunnel Techniques

Time: Three Hours

Maximum Marks: 100

Answer All Questions:-

PART A (10 x 1 = 10 Marks)

1. Reynolds's number is defined as ratio of
 - a. inertia force to viscous force
 - b. viscous force to inertia force
 - c. inertia force to pressure force
 - d. none
2. Scaling ratio (r) is expressed as
 - a. L/l
 - b. $(A/a)^{1/2}$
 - c. $(V/v)^{1/3}$
 - d. all of the above.
3. The strain gauges are usually installed at different points on model to sense the
 - a. change in pressure
 - b. change in flow velocity
 - c. change in mass flow rate
 - d. all of the above
4. The main problem in transonic speed wind tunnel operation is
 - a. Boundary layer
 - b. Liquefaction
 - c. Boundary layer & shock wave interaction
 - d. all of the above.
5. The flow field variable that remains constant across the normal shock in c-d nozzle is
 - a. Stagnation pressure
 - b. Stagnation temperature
 - c. Entropy
 - d. Fluid acceleration
6. The drag occurring due to flow separation over a surface is called
 - a. pressure drag
 - b. skin friction drag
 - c. Wave drag
 - d. induced dra
7. Which kind of shock is preferred in c-d diffuser of supersonic speed wind tunnel
 - a. Weak normal shock
 - b. Oblique shock
 - c. both a & b
 - d. None
8. Laser Doppler velocimetry works on the principle of
 - a. Change in amplitude of reflected light
 - b. Change in wave length of reflected light
 - c. Both a & b
 - d. None
9. The lift produced per unit span is directly proportional to circulation is called as
 - a. Kutta condition
 - b. Kutta Joukowski theorem
 - c. D Alembert's law
 - d. Blasius condition

10. In the wire balanced wind tunnel the model is inverted because
- a. No. of wires required is less b. Reduced turbulence c. Both a & b d. None

PART B (5 x 2 = 10 Marks)

11. Explain the term dynamic similarity.
12. What is meant by subsonic and transonic speed regions?
13. State Buckingham's 'π' theorem.
14. What is the need for cryogenic wind tunnel?
15. Name any two equipments used in the calibration of wind tunnels.
16. Define horizontal buoyancy.
17. What is meant by PIV?
18. Name any two equipments used for the measurement of force?
19. What are the limitations of dye injection method for flow visualization?
20. What is the technique adopted to visualize Shock waves?

PART C (5 x 14 = 70 Marks)

21. a) Derive an expression for thrust (T) developed by a propeller using Buckingham's 'π' method. Assume that $T = f(\rho, V, D, \mu, a, \omega)$. ρ - density of air, V - velocity of flow of air, D - Diameter of a Propeller, μ - dynamic viscosity, a - velocity of sound, ω - angular velocity.

(OR)

- b) Define the following non-dimensional numbers: Weber number, Euler number, Reynolds's number and moment coefficient. How do the model scale effects influence the wind tunnel test results?
22. a) How are the wind tunnels classified? What are the special problems of testing in hypersonic wind tunnels?

(OR)

- b) Sketch the typical layout of a supersonic wind tunnel and mark all the components and subsystems. What is starting problem in supersonic tunnels?

23. a) Write short notes on the following topics:

(i) Flow angularities in wind-tunnel testing (7)

(ii) Turbulence intensity measurements in wind tunnel test section. (7)

(OR)

b) Explain in detail the calibration of a supersonic wind tunnel.

24. a) Explain with neat sketch about the function of a six component balance used for model testing.

(OR)

b) Explain with a neat sketch the working of a hot wire anemometer.

25. a) (i) Briefly describe about the Gun Tunnel with neat sketch. (7)

(ii) Briefly describe about the shock tube with neat sketch. (7)

(OR)

b) Discuss the smoke and tuft grid techniques used for flow visualization.
