KUMARAGURU
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Register Number: ……..

B.E DEGREE EXAMINATIONS: MAY 2015

(Regulation 2009)

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. Mach number is defined as the ratio of_____

   a) inertia force to viscous force b) inertia force to elastic force

   c) inertia force to gravity force d) inertia force to pressure force

2. If the non-dimensional terms in an equation are of order unity, it's called _____form.

   a) Uniform b) Normalized

   c) Regular d) Effective

3. Which kind of shock is preferred in convergent-divergent section of a supersonic wind tunnel

   a) Oblique shock b) Weak normal shock

   c) Both a) & b) d) Strong normal shock

4. The main problem in transonic speed wind tunnel operation is _____

   a) Liquefaction b) Boundary layer & shock wave interaction

   c) Boundary layer d) Buoyancy

5. Mach number adjustment in supersonic tunnel is done by changing _____

   a) Drive-pressure ratio b) Drive-velocity ratio

   c) Nozzle-area ratio d) Diffuser-area ratio

6. The wind tunnel is calibrated because it is difficult to achieve_____

   a) dynamic similarity b) geometric similarity

   c) kinematic similarity d) both a & c

7. Lowest acoustic-resonance frequency (ω) of a closed pipe of length L is _____

   a) a/2L b) a/4L

   c) a/6L d) a/8L

8. Tuft grid technique is used to determine _____

a) Flow properties b) Nature of the flow

c) Forces acting on the model d) Flow injection

9. In blow down tunnels low pressure section is evacuated by _____

a) Blower pump b) Vacuum pump

c) Pressure pump d) Volume pump

10. The Schlieren method is sensitive to the changes of the_____

a) Density second derivative b) Density third derivative

c) Density first derivative d) Density n^{th} derivative

PART B (10 x 2 = 20 Marks)

11. List down the components of wind tunnel.
12. How the lift and drag forces are calculated/measured from the wind tunnel?
13. What is Loss co-efficient in wind tunnel design? Write down its general formula.
14. List down the list of pressure losses in wind tunnel.
15. Why the supersonic tunnel is easier to calibrate than the transonic tunnel? List down the points.
16. How the flow direction in the wind tunnel is measured?
17. Differentiate between external & internal balances of wind tunnel testing.
18. What is non-optical type of flow visualization? Give some example.
19. Write down the importance of supersonic tunnel test section.
20. What is Gladstone-Dale equation? Mention the K's value range for air @ 288K.

PART C (5 x 14 = 70 Marks)

21. a) (i) What is dimensional analysis? Write in detail about its importance in wind tunnel testing. (7)

(ii) List down the various steps involved in Buckingham pi theorem. (7)

(OR)

b) Derive an expression for thrust (T) developed by a propeller using Buckingham pi theorem. Assume that **$T= f(\rho, V, D, \mu, a, \omega)$**

ρ- density of air (kg/m^3), V- velocity of flow of air (m/s), D- Diameter of a Propeller (m),μ- dynamic viscosity (kg/m/s), a- velocity of sound (m/s), ω- angular velocity (rad./s)

22. a) Explain in detail about the closed circuit wind tunnel design process using one example

(OR)

b) Write in detail about the cryogenic wind tunnels with necessary sketches.

23. a) (i) What is the purpose of calibration of wind tunnel? How the wind tunnel test section speed and horizontal buoyancy is calibrated for low speed tunnels? (7)

(ii) With neat sketch explain the procedure to use Turbulence Sphere method. (7)

(OR)

b) Explain in detail about the calibration procedure to find out the mach number distribution in the supersonic wind tunnels.

24. a) Illustrate in detail about the working principles of any three pressure transducer types with neat sketch.

(OR)

b) Explain in detail about any two of the non-optical flow visualization technique available in wind tunnel testing.

25. a) (i) Explain about layouts, sizing and design parameters of hypersonic wind tunnel. (7)

(ii) Explain in detail about the working principle of Gun tunnel (7)

(OR)

b) What is principle behind optical method of flow visualization? Explain in detail about one of its type with neat sketch.

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