Ph.D. COMMON ENTRANCE TEST JANUARY -2025

SUBJECT – AEROSPACE ENGINEERING

PART B

Roll No:

Duration: 60 minutes **Maximum Marks: 50**

Instructions:

1. **This entrance test question paper is not to be taken out of the examination hall**
2. **Question paper consists of Section A and Section B**
3. **Section A consists of 30 MCQs carrying 1 Mark each. Write the Alphabet of the correct answer in the space given.**
4. **Section B consists of Descriptive questions carrying 5 marks each. Restrict your answer to 500 words. Additional plain sheets have been attached to the question paper to answer Section B**

SECTION – A

Answer the following questions by writing the Alphabet of the correct answer in the Box given: **30 X 1 = 30**

1 According to thin airfoil theory, what is the Clα value for a flat plate?
A. 2π
B. π
C. 2/π
D. π/2

2 For subsonic flows, what is the value of the pitching moment coefficient C_m at the quarter chord point? A. Increase with increase in α
B. Decreases with increase in α
C. Does not change with α
D. None of the above

3 The velocity potential exists if the flow is:
A. Irrotational
B. Inviscid
C. Both A and B together
D. None of the above

4 In a boundary layer developing over a flat plate, which force is dominant?
A. Pressure force
B. Capillary force
C. Viscous force
D. Surface tension

5 Kinematic similarity between two flows occurs when the velocities at corresponding points are:
A. in the same direction.
B. differ only by a constant scale factor.
C. in the same direction and differ only by a constant scale factor.
D. none of the above.

6 An incompressible flow implies:
A. Density is constant.
B. Density is not constant.
C. Pressure is constant.
D. Pressure is not constant.

7 What results from removing the cowl from the fan in an aircraft turbo fan engine?
A. Turboprop engine
B. Turbojet engine
C. Ramjet engine
D. Turboshaft engine

8 For a ductile material, the permanent deformation will be:
A. 0.5%
B. 2%
C. 3%
D. ≤1%

9 The Mach number is the ratio of:
A. flow speed to local sonic speed.
B. viscous force to inertia force.
C. pressure force to inertia force.
D. local sonic speed to flow speed.

10 Between the Tresca and Von-Mises failure theories, the more conservative theory is:
A. Tresca
B. Von-Mises
C. Both
D. None

11 The static temperature of the flow across an expansion fan, generated by a sharp corner, is:
A. increases
B. decreases
C. remains constant
D. first increases, then decreases gradually

12 Which of the following is incorrect regarding an axial-flow compressor?
A. Blades are arranged in same manner as in reaction turbine
B. Impeller and diffuser are used to control the mass flow rate in the compressor

C. Flow of air is along the axis of compressor
D. Velocity of air changes when it passes through the blades

13 The critical load of a column with one end fixed and the other end hinged, according to Euler's formula, is:
A. $\pi^2EI/4L^2$
B. $\pi^2EI/2L^2$
C. $\pi^2EI/3L^2$
D. π^2EI/L^2

14 The static pressure of the flow after passing through a normal shock is:
A. increases
B. decreases
C. remains constant
D. first decreases, then increases gradually

15 For a truss if m = 2j-r, m > 2j-r and m < 2j-r, it implies the truss is
A. Redundant, Stable and Deficient
B. Stable, Deficient and Redundant
C. Stable, Redundant and Deficient
D. None of the above

16 Given the following parameters for an optimum solid rocket propulsion system: a chamber pressure of 2.5 MPa, a nozzle throat diameter of 120 mm, a propellant mass flow rate of 8.2 kg/s, a flight velocity of 880 m/s, and a thrust of 20 kN, calculate the specific impulse of the engine.
A. 192 s
B. 228 s
C. 249 s
D. 333 s

17 For a positively cambered airfoil, the lift coefficient C_l when $\alpha=0$ is:
A. Greater than 0
B. Less than 0
C. Equal to 0
D. Undefined

18 What is the reason for choosing a high air-fuel ratio in a gas turbine engine?
A. To increase the output
B. To increase the efficiency
C. To save fuel
D. To reduce the exit temperature

19 Which of the following is the correct relation for the effective spring constant when springs are connected in parallel? (Where K denotes spring stiffness)
A. $K_e = K_1 + K_2$
B. $(1 / K_e) = (1/K_1) + (1/ K_2)$
C. $Ke = (1/K_1) + (1/ K_2)$

D. None of the above

20 A vibration that occurs due to an initial disturbance only is called _____ vibration.
A. Natural
B. Free
C. Forced
D. Random

21 The altitude at which the maximum rate of climb becomes zero is known as:
A. Absolute ceiling
B. Service ceiling
C. Maneuver point
D. Stall point

22 Which of the following is true about the use of flaps in an airplane?
A. Flaps are used to increase stall velocity (V_{stall})
B. Flaps are used to increase the maximum limit of coefficient of lift ($C_{l,max}$)
C. Flaps are used to decrease drag
D. All of the above

23 What are the different types of damping commonly observed?
A. Coulomb and material hysteresis
B. Material hysteresis and structural
C. Coulomb, material hysteresis and structural
D. None of the above

24 The load factor is the ratio of:
A. Lift to Weight
B. Weight to Lift
C. Thrust to Weight
D. Thrust to Drag

25 A cycle that includes two constant pressure processes and two isentropic processes is known as a:
A. Carnot cycle
B. Otto cycle
C. Stirling cycle
D. Brayton cycle

26 What occurs to the energy dissipated by damping?
A. Converted into magnetic field
B. Converted in to electric field
C. Converted in to electromagnetic field
D. Converted into heat

27 Given a rocket with a thrust coefficient of 1.8, an effective jet velocity of 2500 m/s, a propellant mass flow rate of 8.0 kg/s, and an initial vehicle mass of 4000 kg, calculate the theoretical thrust for the rocket.

A. 26 kN
B. 31 kN
C. 36 kN
D. 41 kN

28 The damped natural frequency ω_d can be expressed in terms of the undamped natural frequency ω_n as.

A. $\omega_d = \omega_n\sqrt{1-\zeta^2}$
B. $\omega_n = \omega_d\sqrt{1-\zeta^2}$
C. $\omega_d = \omega_n\sqrt{\zeta^2-1}$
D. $\omega_n = \omega_d\sqrt{\zeta^2-1}$

29 When the speed of a turbine is 6000 rpm, the time taken for the turbine to complete one revolution is _____ seconds.

A. 0.01
B. 0.1
C. 0.001
D. 1.0

30 Which of the following statements is correct about the use of spoilers in an airplane?

A. When spoilers are actuated, lift is destroyed over the wing.
B. Spoiler are used to increase thrust
C. Spoiler are used during take-off to reduce drag
D. Spoiler are used during take-off to increase lift

Section - B

Answer any four questions (Each question carries 5 marks) 4x5 = 20

1. Differentiate between impulse and reaction turbine.
2. Define stagnation pressure. At a point in an airflow the pressure, temperature, and velocity are 1 atm, 320 K, and 1000 m/s. Calculate the stagnation pressure and temperature at this point. Use $(C_p)_{air}$ = 1.005 kJ/kg-K and $(C_V)_{air}$ = 0.718 kJ/kg-K
3. Determine the Euler buckling equation for a critical load of columns with both ends are pinned.
4. Explain thin airfoil. Write the governing equations for thin airfoil and explain its properties and boundary conditions to solve the equations for thin airfoil theory.
5. Analyse the advantages and challenges of using composite materials in aerospace structural applications. Include aspects such as anisotropy, failure mechanisms, manufacturing techniques, and cost considerations.

6. A plate 10 mm thick is subjected to bending moments M x equal to 10 Nm/mm and M y equal to 5 Nm/mm. Obtain the maximum twisting moment per unit length in the plate and the direction of the planes on which this occurs.