GATE 2007 AE 18-24

ee24btech11015 - Dhawal

18) Across a normal shock
   a) both total temperature and total pressure decrease
   b) both total temperature and total pressure remain constant
   c) total pressure remains constant but total temperature decreases
   d) total temperature remains constant but total pressure decreases

19) The Joukowskii airfoil is studied in aerodynamics because
   a) it is used in many aircraft
   b) it is easily transformed into a circle, mathematically
   c) it has a simple geometry
   d) it has the highest lift curve slope among all airfoils

20) One of the criteria for high-speed airplanes is that the critical Mach number should be as high as possible. Therefore, high-speed subsonic airplanes are usually designed with

   a) thick airfoils
   b) thin airfoils
   c) laminar flow airfoils
   d) diamond airfoils

21) Two identical earth satellites A and B are in circular orbits at altitudes h_A and h_B above the earth's surface respectively, with $h_A > h_B$. If E denotes the total mechanical energy, T the kinetic energy and V the gravitational potential energy of a satellite, then:

   a) $E_A > E_B$ and $V_A < V_B$
   b) $E_A > E_B$ and $T_A > T_B$
   c) $E_A < E_B$ and $T_A > T_B$
   d) $E_A > E_B$ and $T_A < T_B$

22) Let P and Q be two square matrices of same size. Consider the following statements

$$PQ = 0 \text{ implies } P = 0 \text{ or } Q = 0 \text{ or both} \tag{1}$$

$$PQ = I^2 \text{ implies } P = Q^{-1} \tag{2}$$

$$(P + Q)^2 = P^2 + 2PQ + Q^2 \tag{3}$$

$$(P - Q)^2 = P^2 - 2PQ + Q^2 \tag{4}$$

where I is the identity matrix. Which of the following statements is correct?

a) 1, 2 and 3 are false, but 4 is true
b) 1, 2 and 4 are false, but 3 is true
c) 2, 3 and 4 are false, but 1 is true
d) 1, 3 and 4 are false, but 2 is true

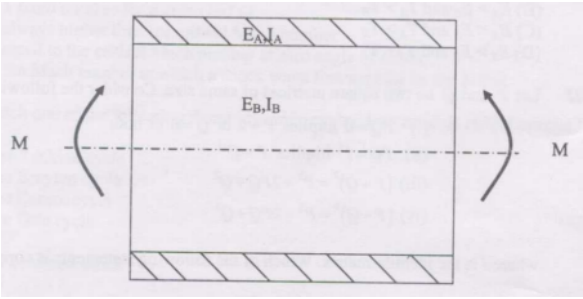
23) A 1 kg mass attached to a spring elongates it by 16 mm. The mass is then pulled from its equilibrium position by 10 mm and released from rest. Assuming the acceleration due to gravity of 9.81 m/s^2, the response of the mass in mm is given by

a) $x = 10\sin(24.76t)$
b) $x = 10\cos(24.76t)$
c) $x = \sin(16t)$
d) $x = 10\cos(16t)$

24) The earth's radius is 6.37×10^6 m and the acceleration due to gravity on its surface is 9.81 m/s^2. A satellite is in a circular orbit at a height of 6.30×10^5 m above the earth's surface. The minimum additional speed it needs to escape from the earth's gravitational field is

a) 3.66×10^3 m/s
b) 3.12×10^3 m/s
c) 3.27×10^3 m/s
d) 3.43×10^3 m/s

25) Shown in the figure below is a model of an Euler-Bernoulli beam made up of two materials subjected to pure bending moment M. The Young's modulus of material A and B are E_A and E_B, respectively. The sectional moment of area, about the neutral axis, of the cross-sectional areas made of materials A and B, are I_A and I_B, respectively. The radius of curvature ρ of the flexural deflection of this composite beam to the bending moment M is then:



a) $\rho = \frac{E_A I_A + E_B I_B}{M}$
b) $\rho = \frac{E_B I_B + E_A I_A}{M}$
c) $\rho = \frac{M}{E_A I_A + E_B I_B}$
d) $\rho = \frac{(E_A + E_B)(I_A + I_B)}{M}$

26) Two pipes of constant sections but different diameters carry water at the same volume flow rate. The Reynolds number, based on the pipe diameter, is:

a) the same in both pipes
b) is larger in the narrower pipe
c) is smaller in the narrower pipe
d) depends on the material of the pipes

27) Two airfoils of the same family are operating at the same angle of attack. The dimensions of one airfoil are twice as large as the other one. The ratio of the minimum pressure coefficient of the larger airfoil to the minimum pressure coefficient of the smaller airfoil is:

a) 4 b) 2 c) 1 d) 0.5

28) Wing A has a constant chord c and span b. Wing B is identical but has a span $4b$. When both wings are operating at the same geometric angle of attack at subsonic speed, then:
   a) wings A and B produce the same lift coefficient
   b) wing A produces a smaller lift coefficient than wing B
   c) wing A produces a greater lift coefficient than wing B
   d) the freestream Mach number decides which wing produces the greater lift coefficient.

29) A spring-mass-damper system is excited by a force $F_0 \sin \omega t$. The amplitude at resonance is measured to be 1 cm. At half the resonant frequency, the amplitude is 0.5 cm. The damping ratio of the system is:

   a) 0.1026 b) 0.3242 c) 0.7211 d) 0.1936

30) The eigenvalues of the matrix, $A = \begin{pmatrix} 2 & 1 \\ 0 & 3 \end{pmatrix}$ are:

   a) 1 and 2 b) 1 and 3 c) 2 and 3 d) 2 and 4

31) The eigenvalues of the matrix A^{-1}, where $A = \begin{pmatrix} 2 & 1 \\ 0 & 3 \end{pmatrix}$ are:

   a) 1 and $\frac{1}{2}$ b) 1 and $\frac{1}{3}$ c) 2 and 3 d) $\frac{1}{2}$ and $\frac{1}{3}$

32) The radius of the earth is 6.37×10^6 m and the acceleration due to gravity at its surface is 9.81 m/s^2. A satellite is in circular orbit at a height of 35.9×10^6 m above the earth's surface. This orbit is inclined at 10.5° to the equator. The velocity change needed to make the orbit equatorial is:
   a) 561 m/s at 84.75° to the initial direction
   b) 561 m/s at 95.25° to the initial direction
   c) 281 m/s at 84.75° to the initial direction
   d) 281 m/s at 95.25° to the initial direction

33) A piston-prop airplane having propeller efficiency, $\eta_p = 0.8$, and weighing 73108 N could achieve maximum climb rate of 15 m/s at flight speed of 50 m/s. The excess Brake Power (BP) at the above flight condition will be:

   a) 1700 kW b) 2100 kW c) 1371 kW d) 6125 kW

34) An airplane model with a symmetric airfoil was tested in a wind tunnel. C_m (moment coefficient, at angle of attack, $\alpha = 0$) was estimated to be 0.08 and 0 respectively for elevator settings (δ_e) of 5° up and 5° down. The estimated value of the elevator control power $\left(\frac{\partial C_m}{\partial \delta_e}\right)$ of the model will be:

a) $0.07/^\circ$ b) $-1.065/^\circ$ c) $-0.008/^\circ$ d) $-0.762/^\circ$