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EE24BTECH11047 - Niketh Prakash Achanta

35) The lateral-directional characteristic equation for an airplane gave the following set of roots: $\lambda_1 = -0.6, \lambda_2 = -0.002, \lambda_{3,4} = -0.06 \pm j1.5$, where $j = \sqrt{-1}$. The damping ratio corresponding to the Dutch-roll mode will be:
   a) 0.04
   b) 0.66
   c) 0.35
   d) 0.18

36) An airplane is flying at an altitude of 10 km above sea level. Outside air temperature and density at 10 km altitude are 223 K and 0.413 kg/m^3 respectively. The airspeed indicator of the airplane indicates a speed of 60 m/s. Density of air at sea level is 1.225 kg/m^3 and the value of the gas constant (R) is 288 J/kg/K. The stagnation pressure P_0 measured by the Pitot tube mounted on the wing tip of the airplane will be of magnitude:
   a) $3.5 \times 10^3 N/m^2$
   b) $2.0 \times 10^4 N/m^2$
   c) $2.87 \times 10^4 N/m^2$
   d) $0.6 \times 10^4 N/m^2$

37) If the center of gravity of an airplane is moved forward towards the nose of the airplane, the C_{Lmax} ($maximum\ value\ of\ the\ lift\ coefficient$) value for which the airplane can be trimmed ($C_m = 0$) will
   a) decrease
   b) increase
   c) remain the same
   d) depend upon rudder deflection

38) If the contribution of only the horizontal tail of an airplane was considered for estimating $\frac{\partial C_m}{\partial \alpha}$, and if the tail moment arm l_t was doubled, then how many times the original value would the new $\frac{\partial C_m}{\partial \alpha}$ become?
   a) two times
   b) three times
   c) 1.414 times
   d) 1.732 times

39) If the vertical tail of an airplane is inverted and put below the horizontal tail, then the contribution to roll derivative $\frac{\partial C_l}{\partial \beta}$ will be:
   a) negative
   b) positive
   c) zero
   d) imaginary

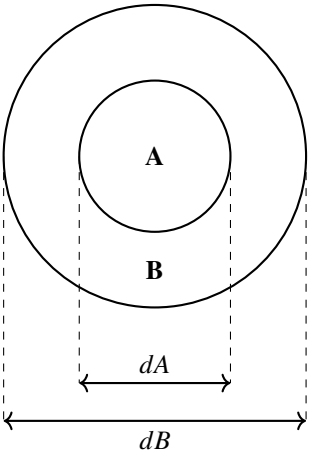
40) Let a system of linear equations be as follows:
$x - y + 2z = 0$
$2x + 3y - z = 0$
$2x - 2y + 4z = 0$
This system of equations has:
a) No non-trivial solution
b) Infinite number of non-trivial solutions
c) A unique non-trivial solution
d) Two non-trivial solutions

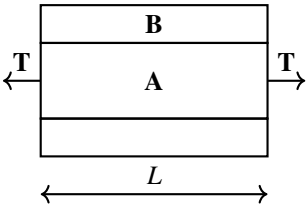
41) A turbulent boundary layer remains attached over a longer distance on the upper surface of an airfoil than does a laminar boundary layer, because:
a) the turbulent boundary layer is more energetic and hence can overcome the adverse pressure gradient better
b) the laminar boundary layer develops more skin friction and hence slows down more rapidly
c) turbulence causes the effective coefficient of viscosity to reduce, resulting in less loss of momentum in the boundary layer
d) the turbulent boundary layer is thicker, hence the velocity gradients in it are smaller, therefore viscous losses are less

42) The laminar boundary layer over a large flat plate held parallel to the freestream is 5 mm thick at a point 0.2 m downstream of the leading edge. The thickness of the boundary layer at a point 0.8 m downstream of the leading edge will be:
a) 20 mm
b) 10 mm
c) 5 mm
d) 2.5 mm

43) If horizontal tail area is increased while the elevator to horizontal tail area ratio is kept the same, then:
a) both longitudinal static stability and elevator control power will increase
b) only longitudinal static stability will increase
c) only elevator control power will increase
d) neither stability nor control power changes

44) A circular shift is made-up of two materials A and B. The inner core is made-up of material A with diameter d_λ, torsion constant J_A,a nd shear modulus G_A. The outer sleeve is made-up of material B with diameter d_B, torsion constant J_B, and shear modulus G_B. The composite shaft is of length L and is subjected to pure torsion moment T. The torsional stiffness, $\frac{T}{\phi}$, where ϕ is the angle of twist, of this composite shaft





is then

a) $\frac{(G_A J_A - G_B J_B)}{(G_A J_A + G_B J_B)}$
b) $\frac{G_A J_A + G_B J_B}{L}$
c) $\frac{(G_A + G_B)(J_A + J_B)}{L}$
d) $\frac{G_A J_B + G_B J_A}{L}$

45) Air enters through the eye of a centrifugal compressor with a stagnation temperature 300K and exits the compressor with a stagnation temperature 424K. If the isentropic efficiency of the compressor is 0.81 and the ratio of specific heats of the flowing gas (*assumed as constant*) is 1.4, then the pressure ratio across the compressor is

a) 2.75
b) 5.60
c) 65.00
d) 228.00

46) The boundary conditions for an Euler-Bernoulli column are given in column X and the critical buckling loads are given in column Y. Match the boundary condition of the column to its corresponding buckling load, P_σ is the critical buckling load, E is the Young's modulus of the column material, I its sectional moment of area, and L is the length of the column.

a) X1-Y4,X2-Y3,X3-Y1,X4-Y2
b) X1-Y4,X2-Y2,X3-Y3,X4-Y1
c) X1-Y4,X2-Y1,X3-Y2,X4-Y3
d) X1-Y4,X2-Y3,X3-Y2,X4-Y1

X. Boundary condition	Y. Critical buckling load
X1. Pinned-pinned column	Y1. $P_\sigma = \frac{4\pi^2 EI}{L^2}$
X2. Fixed-free (*cantilevered*) column	Y2. $P_\sigma = \frac{2.046\pi^2 EI}{L^2}$
X3. Fixed-fixed column	Y3. $P_\sigma = \frac{\pi^2 EI}{4L^2}$
X4. Fixed-pinned column	Y4. $P_\sigma = \frac{\pi^2 EI}{L^2}$

TABLE 46

47) For an impulse turbine with identical stages, the hot gas exits from the stator blades at the mean blade height at an absolute angle of 70 degrees with the axis of the turbine. If the absolute inlet blade angle with the axis of the turbine at the mean blade height for the rotor blades is 37 degrees, then the absolute exit blade angle with the axis of the turbine at the mean blade height of the rotor blades is:
    a) 33 degrees
    b) 37 degrees
    c) 53 degrees
    d) 53.5 degrees
48) Which one of the following materials should be selected to design an axial flow turbine operating at high temperatures?
    a) Steel alloy
    b) Titanium alloy
    c) Nickel alloy
    d) Aluminum alloy
49) Which one of the following statements is true?
    a) The isentropic efficiency of a compressor is constant throughout the compressor
    b) Flow separation problems are more critical for the axial compressors than for the centrifugal compressors
    c) The pressure ratio of a centrifugal compressor approaches zero as the compressor mass flow rate approaches zero
    d) Centrifugal compressors are always designed with multiple stages
50) An athlete starts running with a speed V_0. Subsequently, his speed decreases by an amount that is proportional to the distance that he has already covered. The distance covered will be:
    a) Linear in time
    b) Quadratic in time
    c) Exponential in time
    d) Logarithmic in time
51) The on-board rocket motor of a satellite of initial mass 2000 kg provides a specific impulse of 280 seconds. If this motor is fired to give a speed increment of 500 m/s along the direction of motion, the mass of propellant consumed is:
    a) 685 kg
    b) 333 kg

c) 1666 kg
d) 167 kg