ae-2017-1 to 13

AI24BTECH11020 - Rishika

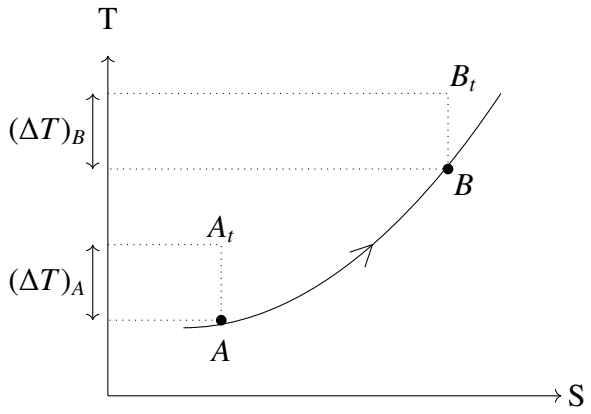
1) Given the vectors $\mathbf{v_1} = \hat{i} + 3\hat{j}; \mathbf{v_2} = 2\hat{i} - 4\hat{j} + 3\hat{k}$, the vector $\mathbf{v_3}$ that is perpendicular to both $\mathbf{v_1}$ and $\mathbf{v_2}$ is given by:
   a) $\mathbf{v_3} = \mathbf{v_1} - (\mathbf{v_1} \cdot \mathbf{v_2}) \frac{\mathbf{v_2}}{\|\mathbf{v_2}\|}$
   b) $\mathbf{v_3} = \hat{k}$
   c) $\mathbf{v_3} = \mathbf{v_2} - (\mathbf{v_1} \cdot \mathbf{v_2}) \frac{\mathbf{v_1}}{\|\mathbf{v_1}\|}$
   d) $\mathbf{v_3} = \frac{\mathbf{v_1} \times \mathbf{v_2}}{\|\mathbf{v_1} \times \mathbf{v_2}\|}$
2) The value of the integral $I = \int_c \left((x - y)\, dx + x^2 dy\right)$, with C the boundary of the square $0 \le x \le 2; 0 \le y \le 2$, is _____
3) Let $\mathbf{v}(\mathbf{t})$ be a unit vector that is a function of the parameter t. Then $\mathbf{v} \cdot \frac{d\mathbf{v}}{dt}$ = _____
4) The eigenvalues λ_n and eigenfunctions $u_n(x)$ of the sturm-Liouville problem

$$\frac{d^2y}{dx^2} + k^2\lambda y = 0, 0 < x < 1; y(0) = 0, y(1) = 0$$

   are given by:
   a) $\lambda_n = n^2\pi^2; u_n(x) = \sin \lambda_n x, n = 0, \pm 1, \pm 2, \cdots, \infty$
   b) $\lambda_n = \frac{n^2\pi^2}{k^2}; u_n(x) = \sin kn\pi x, n = 0, \pm 1, \pm 2, \cdots, \infty$
   c) $\lambda_n = \frac{n^2\pi^2}{k^2}; u_n(x) = \sin n\pi x, n = 0, \pm 1, \pm 2, \cdots, \infty$
   d) $\lambda_n = n^2\pi^2; u_n(x) = \sin n\pi x, n = 0, \pm 1, \pm 2, \cdots, \infty$
5) 3-point Gaussian integration formula is given by: $\int_{-1}^{1} f(x)\, dx \approx \Sigma_{j=1}^{3} A_j f\left(x_j\right)$ with $x_1 = 0, x_2 = -x_3 = -\sqrt{\frac{3}{5}}; A_1 = \frac{8}{9}, A_2 = A_3 = \frac{5}{9}$. This formula exactly integrates
   a) $f(x) = 5 - x^7$
   b) $f(x) = 2 + 3x + 6x^4$
   c) $f(x) = 13 + 6x^3 + x^6$
   d) $f(x) = e^{-x^2}$
6) Which one of the following statements is NOT true
   a) The pitching moment of any airfoil at any angle of attack is always zero at the center of pressure
   b) The pitching moment of any airfoil at any angle of attack is always zero at the aerodynamic center
   c) The center of pressure and aerodynamic center coincide for a symmetric airfoil
   d) The pitching moment about the aerodynamic center,for any airfoil, does not vary with angle of attack
7) Which one of the following statements is NOT true
   a) Compared to a laminar boundary layer, a turbulent boundary layer is more desirable on a wing operating at large angle of attack
   b) The skin friction drag for a turbulent boundary layer is larger than that for a laminar boundary layer
   c) The location of transition from laminar to turbulent boundary layer depends only on the operating Reynolds number
   d) A seperated flow does not necessarily lead to a turbulent boundary layer

8) A De Laval nozzel is to be designed for an exit Mach number of 1.5. The reservoir conditions are given as $P_\circ = 1atm(gage), T_\circ = 20^\circ C, \gamma = 1.4$. Assuming shock free flow in the nozzle, the exit absolute pressure(in atm) is _____ (in three decimal places)

9) Consider a steady one dimensional flow of a perfect gas with heat transfer in a duct. The T-s diagram (shown below) shows both the static and the stagnation conditions at two locations, A and B,in the duct. A_t and B_t denote stagnation conditions for states A and B, respectively. It is known that $(\Delta T)_A = (\Delta T)_B$ .M_A and M_B are the Mach numbers of the flow at locations A and B.



Which of the following statements is true about the flow.

a) Flow is subsonic and $M_A < M_B$
b) Flow is supersonic and $M_A > M_B$
c) Flow is subsonic and $M_A > M_B$
d) Flow is supersonic and $M_A < M_B$

10) To ensure only the longitudinal static stability (and not the condition for equilibrium) of a low speed aircraft, the aircraft components must be designed to satisfy which one of the following conditions:

a) $\frac{\partial C_m}{\partial \alpha} < 0$ and $C_{m0} > 0$
b) $\frac{\partial C_m}{\partial \alpha} < 0$
c) $\frac{\partial C_m}{\partial C_L} < 0$ and $C_{m0} < 0$
d) $\frac{\partial C_m}{\partial C_L} = 0.0$

11) Which of the following statement(s) is/are true about the shear centre of a cross-section:
P: It is that point in the cross-section through which shear loads produce no twisting.
Q: This point is also the centre of twist of sections subjected to pure torsion.
R: The normal stress at this point is always zero.

a) P, Q and R
b) P only
c) P and Q only
d) P and R only

12) Let $\overline{N_m}$ and $\overline{N_0}$ be respectively the non-dimensional locations of the stick-fixed maneuver point and stick-fixed neutral point of a low speed convectional aircraft. These distances are measured with respect to the nose of the fuselage. The numerical value of $\overline{N_m} - \overline{N_0}$

a) will always be negative
b) will always be positive
c) will always be zero
d) can have any value depending on the location of the center of gravity of the aircraft