2011 AE 27-39

EE24BTECH11051 - Prajwal

1) Consider a beam in bending with a solid circular cross-section of $1mm^2$, which is subjected to a transverse shear force of $1N$. The shear stress at the center of the cross-section (in N/mm^2) is ...
2) A simply supported slender column of square cross section (width=depth=d) has to be designed such that it buckles at the same instant as it yields. Length of the column is given to be $1.57m$ and it is made of a material whose Youngâs modulus is $200GPa$ and yield stress is $240MPa$. The width, d, of the column (in cm) should be ...
3) A turbojet powered aircraft is flying at Mach number 0.8 at an altitude of $10km$. The inlet and exit areas of the engine are $0.7m^2$ and $0.4m^2$ respectively. The exhaust gases have velocity of $500m/s$ and pressure of $60kPa$. The free stream pressure, density and speed of sound are $26.5kPa$, $0.413kg/m^3$ and $299.5m/s$ respectively. The thrust of the engine (in kN) is ...
4) A low speed wind tunnel has a contraction ratio of 14 : 1 and the cross-sectional area of the test section is $1m^2$. The static pressure difference between the settling chamber and the test section is $40cm$ of water column. Assume $g = 9.81m/s^2$,$\rho_{air} = 1.2kg/m^3$ and $\rho_{water} = 1000kg/m^3$. The speed of air in the test section (in m/s) is ...

Question Q.31 to Q.55 multiple choice type

5) Consider the function $f(x) = x - \sin x$. The Newton-Raphson iteration formula to find the root of the function starting from an initial guess at $x^{(0)}$ iteration k is

a) $x^{(k+1)} = \frac{\sin x^{(k)} - x^{(k)} \cos x^{(k)}}{1 - \cos x^{(k)}}$
b) $x^{(k+1)} = \frac{\sin x^{(k)} - x^{(k)} \cos x^{(k)}}{1 + \cos x^{(k)}}$
c) $x^{(k+1)} = \frac{\sin x^{(k)} + x^{(k)} \cos x^{(k)}}{1 - \cos x^{(k)}}$
d) $x^{(k+1)} = \frac{\sin x^{(k)} + x^{(k)} \cos x^{(k)}}{1 + \cos x^{(k)}}$

6) Consider the matrix $\begin{bmatrix} 2 & a \\ b & 2 \end{bmatrix}$ where a and b are real numbers. The two eigenvalues of this matrix λ_1 and λ_2 are real and distinct ($\lambda_1 \neq \lambda_2$) when

a) $a < 0$ and $b > 0$ b) $a > 0$ and $b < 0$ c) $a < 0$ and $b < 0$ d) $a = 0$ and $b = 0$

7) the solution of $\frac{dy}{dt} = y^3 e^t t^2$ with initial condition $y(0) = 1$ is given by

a) $\frac{1}{9} e^t (t + 3)^2$
b) $\sqrt{\frac{9}{5 + 2e^t (t^2 - 2t + 2)}}$
c) $\frac{4e^t}{(t+2)^2}$
d) $\sqrt{\frac{1}{5 - 2e^t (t^2 - 2t + 2)}}$

8) A jet engine is operating at a Mach number of 0.8 at an altitude of $10km$. The efficiency of the air intake is 0.8 and that of the compressor is 0.87. The total temperatures (in K) at the exits of the air intake and the compressor respectively are
(Amibient presure=26.5kPa;Ambient temperature =223.3K;Gas constant,$\gamma = 1.4$;p_{rc}=8)

a) 251.9 and 458.2 b) 234.9 and 486.8 c) 252.9 and 486.8 d) 234.9 and 458.2

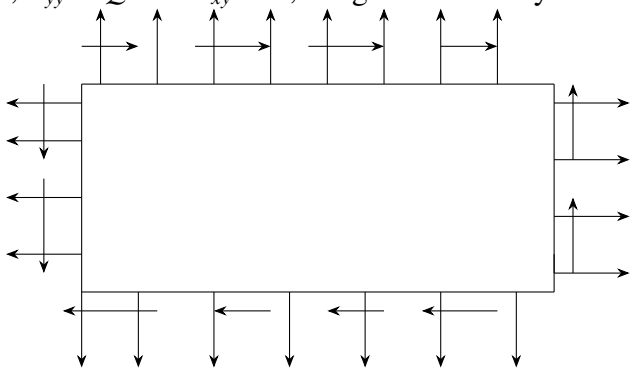
9) A rocket engine is tested on a test bed under the ideal condition of fully expanded jet. The exhaust velocity is 2 km/s through a nozzle of area 2.5 m^2. The mass flow rate is 200 kg/s. The specific impulse of the propellant and the thrust developed respectively are (assume g = 9.81 m/s^2)

a) 175.87 s and 200 kN
b) 203.87 s and 400 kN
c) 231.87 s and 200 kN
d) 280.87 s and 400 kN

10) A body undergoes deformation under plane strain conditions when subjected to the following stresses (in MPa): $\rho_{xx} = 450, \rho_{yy} = 450, \tau_{xy} = 75, \tau_{xz} = 0, \tau_{yz} = 0$.What are the remaining components of stresses (in MPa) and strains? Assume the material to be isotropic and linear-elastic $v = \frac{1}{3}$

a) $\sigma_{zz} = 0, \epsilon_{xx} = 0.00225, \epsilon_{xx} = 0.00225, \gamma_{xy} = 0.002, \gamma_{xz} = 0, \gamma_{yz} = 0$
b) $\sigma_{zz} = 300, \epsilon_{xx} = 0.001, \epsilon_{yy} = 0.001, \gamma_{xy} = 0.001, \gamma_{xz} = 0, \gamma_{yz} = 0$
c) $\sigma_{zz} = 300, \epsilon_{xx} = 0.00225, \epsilon_{yy} = 0.00225, \gamma_{xy} = 0.001, \gamma_{xz} = 0, \ \gamma_{yz} = 0$
d) $\sigma_{zz} = 0, \epsilon_{xx} = 0.001, \epsilon_{yy} = 0.001, \gamma_{xy} = 0.002, \gamma_{xz} = 0, \ \gamma_{yz} = 0$

11) Which of the following Airyâs stress functions could satisfy the given boundary conditions,assuming constant values of $\sigma_{xx} = P, \sigma_{yy} = Q$ and $\tau_{xy} = R$,along tha boundary?



a) $\phi = P\frac{x^2}{2} + Q\frac{y^2}{2} - Rxy$
b) $\phi = P\frac{y^2}{2} + Q\frac{x^2}{2} + Rxy$
c) $\phi = P\frac{y^2}{2} + Q\frac{x^2}{2} - Rxy$
d) $\phi = P\frac{x^2}{2} + Q\frac{y^2}{2} + Rxy$

12) An aircraft is performing a coordinated turn manoeuvre at a bank angle of 30o and forward speed of 100 m/s. Assume g = 9.81ms⁻2. The load factor and turn radius respectively are

a) $(\frac{2}{\sqrt{3}})$ and 1.76 km
b) $\sqrt{3}$ and 17.6 km
c) 2 and 0.18 km
d) $\left(\frac{2}{\sqrt{3}}\right)$ and 17.6 km

13) An aircraft in a steady level flight at forward speed of 50 m/s suddenly rolls by 180o and becomes inverted. If no other changes are made to the configuration or controls of the aircraft, the nature of the subsequent flight path taken by the aircraft and its characteristic parameter(s) (assume g = 9.81 ms^{-2}) are

a) straight line path with a speed of 50 m/s
b) upward circular path with a speed of 50 m/s and radius of 127.4 m
c) downward circular path with a speed of 50 m/s and radius of 127.4 m/s
d) downward circular path with a speed of 25 m/s and radius of 254.8 m/s