Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.TECH/ME(N)/PE(N)/AUE(N)/PWE(N)
/SEM-3/ME-302/2012-13

2012

STRENGTH OF MATERIAL

Time Allotted : 3 Hours *Full Marks* : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

GROUP – A

(Multiple Choice Type Questions)

1. Choose the correct alternatives for any *ten* of the following :

$10 \times 1 = 10$

i) A simply supported beam of span L is carrying a point load W at the mid-span. What is the deflection at the centre of the beam ?

a) $\frac{WL^2}{48EI}$ b) $\frac{WL^3}{48EI}$

c) $\frac{5WL^3}{348EI}$ d) $\frac{11WL^2}{120EI}$.

ii) If two springs of stiffnesses K_1 and K_2 are connected in series, then the stiffness of the composite spring is given by

a) $K_1 + K_2$ b) $\frac{1}{K_1} + \frac{1}{K_2}$

c) $\frac{1}{K_1} - \frac{1}{K_2}$ d) $K_1 - K_2$.

iii) The maximum value of the Poisson's ratio for any material is given by

a) 1 b) – 1

c) $\sqrt[3]{3}$ d) 0·5.

iv) In a cantilever beam with UDL, the shear force diagram is

a) parabolic b) linear

c) cubic d) constant.

v) When a shear force along a section is zero

a) BM is maximum or minimum

b) BM is zero

c) BM is infinity

d) BM is unpredictable.

vi) Section modulus of a section is

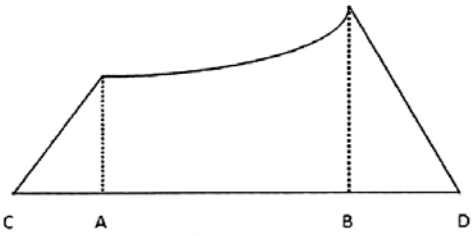
a) ratio of the maximum bending moment to the moment of inertia of the section

b) proportional to the area of the section

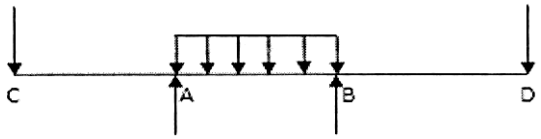
c) Ratio of bending stress to the moment of inertia of the section

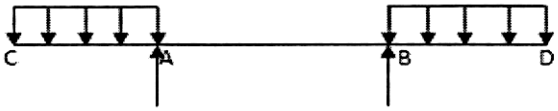
d) none of these.

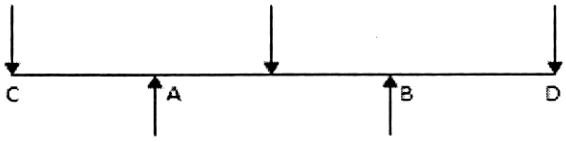
vii) The figure given below shows a BM diagram for the beam *CABD*.



Load diagram for the above beam will be

a)


b)


c)


d) none of these.

viii) Power transmitted by a shaft rotating at N rpm under a mean torque of T (Nm) is

a) $2\pi NT/60$ watts b) $2\pi NT/60$ kilowatts

c) $2\pi NT/60$ hp d) none of these.

ix) Hook's law holds good upto

a) yield point b) elastic limit

c) plastic limit d) breaking point.

x) For circular section of diameter d, the section modulus is

a) $\pi d^2/64$ b) $\pi d^3/32$

c) $\pi d^4/16$ d) $\pi d^2/4$.

xi) The buckling load for a given material depends upon

a) Poisson's ratio and Slenderness ratio

b) Poisson's ratio and Modulus of elasticity

c) Slenderness ratio and c/s area

d) Slenderness ratio and Modulus of elasticity.

xii) The buckling load for a given material depends upon

a) Poisson's ratio and Slenderness ratio

b) Poisson's ratio and modulus of elasticity

c) Slenderness ratio and cross-sectional area

d) Slenderness ratio and modulus of elasticity.

GROUP – B

(Short Answer Type Questions)

Answer any *three* of the following $3 \times 5 = 15$

2. A solid conical bar of uniformly varying diameter has D at one end and zero at the other end. If length of the bar is L, modulus of elasticity E and unit weight γ, find the extension of the bar due to self weight only.

3. Prove that $E = 2G(1+\nu)$, where E = Young's Modulus of Elasticity, G = Modulus of Rigidity and ν = Poisson's ratio.

4. A closed coiled helical spring is required to carry a load of 150 N. If the mean coil diameter is to be 8 times that of wire, calculate these diameters. Take maximum shear stress as 100 MPa.

5. Determine the diameter of solid shaft which will transmit 440 KW at 280 rpm. The angle of twist must not exceed one degree per meter length and the maximum torsional shear stress is to be limit to 40 N/mm^2. Assume G = 84 KN/mm^2.

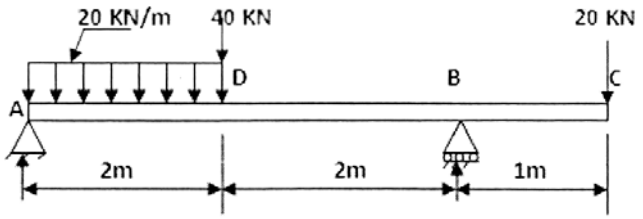
6. A cantilever beam of 1 m long carries a gradually varying load, zero at the free end to w KN/m at the fixed end. Draw BM and SF diagrams for the beam.

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. $3 \times 15 = 45$

7. a) Draw the shear force and bending moment diagrams for the beam shown in figure.



b) What is point of contraflexure ? Derive the relationship between load intensity, shear force and bending moment. 9 + 6

8. a) For a thin walled cylindrical pressure vessel deduce the expressions for circumferential stress and longitudinal stress.

b) The state of stress at a point are given $\sigma_{xx} = 150$ MPa, $\sigma_{yy} = -50$ MPa and $\tau_{xy} = 25$ MPa. Determine

i) Principal stresses and their directions

ii) Shear stresses and their directions. If the plane is inclined at 50° with *XX*. 5 + 10

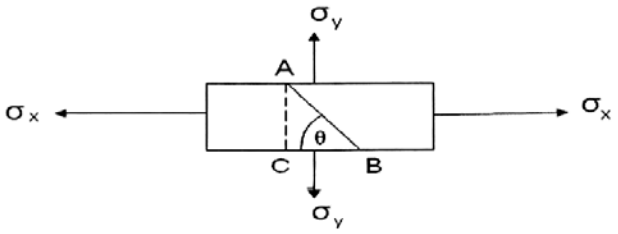
9. a) Derive the torsion equation for a circular shaft of diameter *D* and subjected to a twisting moment *T*.

b) A solid shaft of 200 mm diameter has the same cross-sectional area as a hollow shaft of the same material with inside diameter of 150 mm. Find the ratio of

i) Powers transmitted by both the shafts at the same angular velocity

ii) Angles of twist in equal lengths of these shafts, when stressed to the same intensity. 5 + 10

10. a) Find the expression of normal stress and shear stress on an oblique section of a body subjected to direct stresses in two mutually perpendicular directions as shown in figure.



b) Draw the Mohr's circle and find the expression of normal and shear stress on an oblique section of a body subjected to direct stress in one plane.

c) Determine the expression for normal and tangential stresses on a plane at θ to the plane of stress in *x*-direction in a two dimensional stress system and show that (i) sum of normal stresses in any two mutually perpendicular directions is constant, (ii) principal planes are planes of maximum normal stresses also. 4 + 4 + 7

11. a) Derive an expression for the critical load in a long column when its one end is fixed and other is hinged.

b) A hollow circular column of steel, of outer diameter 200 mm and thickness 5 mm has a length of 4 m, with both ends fixed. Find the Euler critical load if E = 200 GPa. if the yield stress is 300 MPa, determine the length below which Euler's formula cannot be applied.

c) Two shafts AB and BC are connected in series. The diameter of AB and BC are respectively 100 mm and 50 mm and their lengths are 2 m and 3 m respectively both the shafts are made of the same material having modulus of rigidity as 8×10^4 N/mm^2. Determine (i) Shear stress set up in each shaft and (ii) the angle of twist. Take torque applied at one end is 10^4 N-m.

5 + 5 + 5

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