Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.TECH (AUE)(O)/SEM-3/AUE-301/2012-13

2012

STRENGTH OF MATERIALS

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 of the following : $10 \times 1 = 10$

   i) The point in a stress-strain curve at which neck formation starts is called

      a) ultimate stress

      b) breaking stress

      c) yield stress.

   ii) If Young's modulus, rigidity modulus and Poisson's ratio of a material are E, G and μ respectively, then

      a) $E = 2G(1 - \mu)$ b) $E = 2G(1 + \mu)$

      c) $E = \mu G$ d) $E = G$.

iii) The maximum bending moment in a simply supported beam of length l and a point load P at the middle is

a) $Pl/2$ b) Pl

c) $Pl/8$ d) $Pl/4$.

iv) In a cantilever with U.D.L. the shear force diagram is

a) parabolic b) linear

c) cubic d) any of these.

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

a) $\pi d^4/64$ b) $\pi d^3/32$

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

vi) Where shear force changes sign, the bending moment is

a) zero b) increasing

c) maximum d) minimum.

vii) The maximum bending moment at the fixed end of a cantilever beam of span l carrying a U.D.L. of intensity ω over the entire span is

a) $\omega l^2/2$ b) ωl^2

c) $\omega l/2$ d) $\omega l/4$.

viii) A strut is a member which carries

a) tensile load

b) compressive load

c) both tensile and compressive loads.

ix) Shape of the core in rectangular section is

a) square b) triangle

c) rhombus d) none of these.

x) 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.

GROUP – B
(Short Answer Type Questions)

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

2. Establish a relation between Young's modulus (E), modulus of rigidity (G) and Poisson's ratio (μ).

3. Derive the basic torsional equation : $\frac{T}{J} = \frac{\tau}{r} = \frac{G\theta}{l}$, the notations have their usual meaning.

4. Find out the expressions for Euler's critical load for column, the ends of which are both fixed.

5. For a thin walled pressure vessel establish the relationship $\frac{\sigma_1}{r_1} + \frac{\sigma_2}{r_2} = \frac{p}{t}$, where σ_1, σ_2 are the membrane stresses, r_1, r_2 are the radii of curvature in meridional and circumferential directions, p is the internal gas pressure and t is the wall thickness of the vessel.

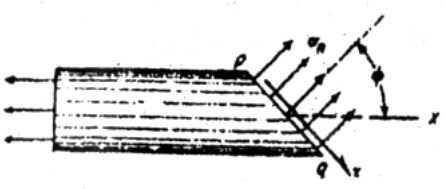
6. Derive expression for finding out shear stress at any point on the cross-section of a circular shaft subjected to an external torque.

GROUP – C

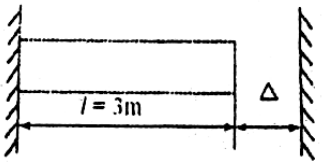
(Long Answer Type Questions)

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

7. a) A prismatic bar carrying an axial tensile stress σ_x is cut by an oblique section *pq* as shown in figure below. If the normal and shear stresses, respectively, on this section are σ_n = 825 kg/cm^2 and τ = 275 kg/cm^2, find the value of σ_x and angle Φ defining the aspect of the section *pq*.



b) A bronze bar 3 m long with a cross-sectional area of 320 mm^2 is placed between two rigid walls, as shown in figure below. At a temperature of –20°C, the gap Δ = 2·5 mm. Find the temperature at which the compressive stress in the bar will be σ = 35 MPa, Use $\propto = 18 \times 10^{-6}$ /°C and E = 80 GPa.

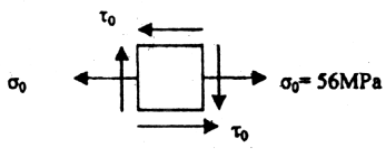


7 + 8

8. a) A state of plane stress consists of a tensile stress σ_0 = 56 MPa exerted on vertical surfaces and of unknown shearing stresses as shown in the figure below. Determine

i) the magnitude of shearing stress τ_0 for which the largest normal stress is 70 MPa.

ii) the corresponding maximum shearing stress.

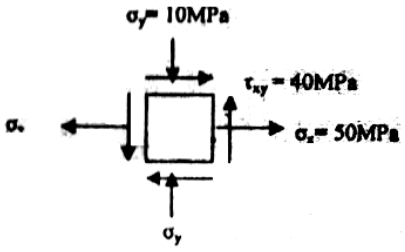


b) For the state of plane stress shown in figure below

i) construct Mohr's circle

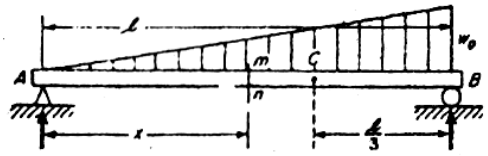
ii) determine the principal stresses

iii) determine the maximum shearing stress and corresponding normal stress.

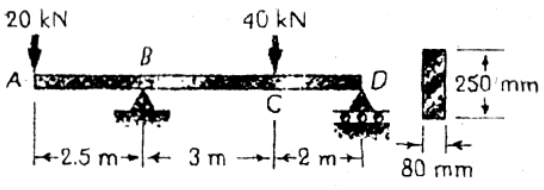


6 + 9

9. a) A simple beam *AB* carries a triangular distribution of transverse load as shown in figure below, the maximum intensity of load at *B* being w_0. At what cross-section (defined by x) does the maximum bending moment occur and what is its magnitude ?



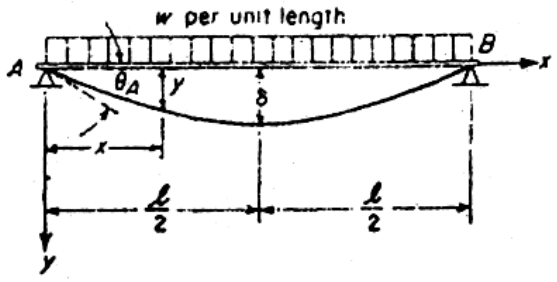
b) For the timber beam and loading shown in figure below, draw the shear and bending moment diagram and determine the maximum normal stress due to bending.



7 + 8

10. a) A hollow cast from iron whose outside diameter is 200 mm and has a thickness of 20 mm is 4·5 m long and is fixed at both ends. Calculate the safe load by Rankine's formula using a factor of safety of 2·5. Find the ratio of Euler's to Rankine's load. Take $E = 1\times10^5$ N/mm^2 and Rankine's constant = 1/1600 for both end pinned case and σ_c = 550 N/mm^2.

b) A simply supported prismatic beam *AB* carries a uniformly distributed load of intensity ω over its span l as shown in figure below. Develop the equation of the elastic line and find the maximum deflection δ at the middle of the span.



8 + 7

11. Write short notes on any *three* of the following : 3 × 5

a) Point of contraflexure

b) Slenderness ratio

c) Rankine's formula for crippling load

d) Shear stress in rectangular beam.

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