FUNDAMENTALS OF STRENGTH OF MATERIALS
(CIVL 2101)

Time Allotted : 3 hrs **Full Marks : 70**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

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

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**

(i) Maximum bending moment in a simply supported beam carrying an udl (w kN/m) is
(a) $wl^2/8$ (b) $wl^2/4$ (c) $wl^3/4$ (d) $wl^2/2$.

(ii) At the point of contraflexure
(a) Bending moment is zero (b) Bending moment is maximum
(c) Shear force is zero (d) Bending moment changes its sign.

(iii) Maximum deflection of a simply supported beam with a total udl W is
(a) $Wl^3/384EI$ (b) $5Wl^3/384EI$
(c) $Wl^3/48EI$ (d) $5Wl^3/48EI$.

(iv) The shape of the bending moment diagram for a simply supported beam carrying udl will be
(a) Triangular (b) parabolic (c) circular (d) cubical.

(v) An I-section is subjected to a shear force F. The maximum shear stress will occur at
(a) Top of the section (b) neutral axis of the section
(c) junction of web and flange (d) bottom of the section.

(vi) For an isotropic, homogeneous and elastic material obeying Hooke's law, the number of independent elastic constants is
(a) 1 (b) 2 (c) 3 (d) 4.

(vii) Angle of obliquity is defined as
(a) Angle between the plane on which stresses are evaluated and one of the given planes
(b) Angle between resultant stress and the plane of given normal stress
(c) Angle between resultant stress and shear stress
(d) Angle between resultant stress and normal stress.

(viii) For an element subjected to pure shear stress τ N/mm^2, the maximum principal stress will be
(a) 2τ (b) $\tau/2$ (c) τ (d) 4τ.

(ix) A material is referred to as perfectly rigid if modulus of elasticity of the material is
(a) Infinity (b) Zero (c) Equal to carbon (d) Unity.

(x) The major and minor principal stresses at a point are 120 MPa and 60 MPa respectively. On a plane passing through the point, the shear stress is 15 MPa. What is the angle of this plane with the plane of major principal stress?
(a) 45^0 (b) 30^0 (c) 15^0 (d) 60^0.

Group – B

2. (a) What is the difference between ductile and brittle material in failure under tension?

(b) What is Poisson's ratio?

(c) Prove $K = E/3(1-2\mu)$
where, K = Bulk modulus, E = Modulus of elasticity, μ = Poisson's ratio.

2 + 2 + 8 = 12

3. Find out the position of centroid of the following figure along both the axes. X-X and Y-Y are the two centroidal axes in the figure and Z-Z is the axis parallel to X-X axis and passing through the base of the figure. Determine the moment of inertia of the figure shown below about all the three axes.

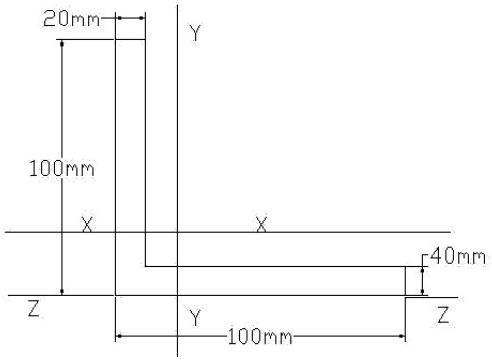

Fig.1

12

Group – C

4. Construct the shear force diagram (SFD) and bending moment diagram (BMD) of the figures shown below.

(a)

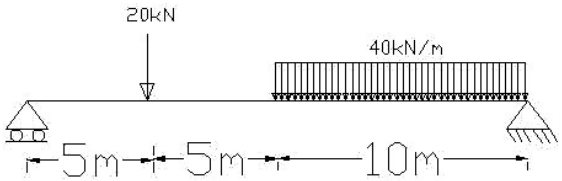

Fig.2

(b)

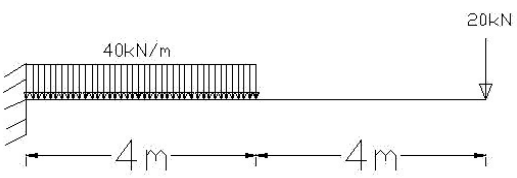

Fig.3

6 + 6 = 12

5. (a) Two timber pieces of section 70x110 mm. are joined with epoxy along a plane inclined at 30^0 to the x-axis. Find the maximum force the member can sustain if the strength of the joint is 5 MPa in tension and 3 MPa in shear.

   (b) At a point inside a loaded material, σ_x = +100 MPa, σ_y = - 40 MPa, τ_{xy} = 30MPa. Locate the orientation of principal plane, calculate magnitude of principal stress and maximum shear stress using Mohr's Circle method.

5 + 7 = 12

Group – D

6. (a) A beam is simply supported over a length of 6m. It carries a udl of 12 kN/m and a point load of 9 kN at 2.5 m from the left support. If the bending stress in the timber does not exceed 8 MPa, design a suitable section making the depth twice the width.

   (b) Write down the assumptions in theory of simple bending.

8 + 4 = 12

7. (a) Write down the advantages and disadvantages of truss.

   (b) Determine the torque that can be applied to a solid shaft of 20 mm. diameter without exceeding an allowable shearing stress of 65 N/mm^2. What torque can be applied if this solid shaft is replaced by a hollow shaft of the same sectional area with the inner diameter equal to half its outer diameter?

6 + 6 = 12

Group – E

8. (a) Calculate the value of deflection at the mid-point and rotation at the left support of the simply supported beam as shown below using double integration method. Assume EI to be constant throughout.

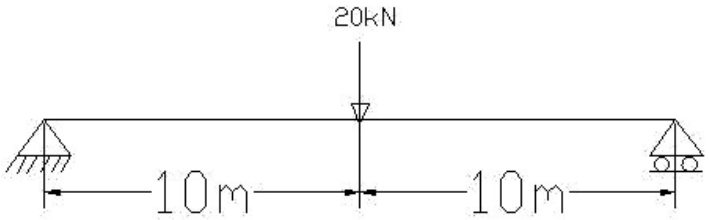

Fig.4

   (b) Derive the expression of strain energy stored in a beam due to bending.

10 + 2 = 12

9. (a) Determine the lateral deflections at failures of a 5 m. long aluminium column of 100 mm. external diameter and 6 mm. wall thickness for 'both ends hinged' and 'both ends fixed' boundary conditions. Assume a yield stress of 300 MPa and Young's modulus of 75 GPa.

(b) Find out the critical load for a long column having one end fixed and other end free using Euler's theory. The column has length '*l*', uniform cross-sectional area 'A' and rigidity 'EI'.

6 + 6 = 12

Department & Section	Submission Link
CE A	https://classroom.google.com/c/ODk5NzkyMzk3OTRa/a/MjczODMyNjY2NDU0/details
CE B	https://classroom.google.com/c/ODk5NzkyMzk4NDFa/a/MjczODMyNjY2NTIx/details