II B. Tech I Semester Regular Examinations, March - 2021
STRENGTH OF MATERIALS - I
(Civil Engineering)

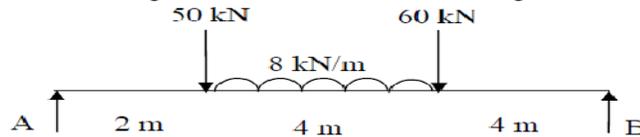Time: 3 hours   Max. Marks: 75

Answer any **FIVE** Questions each Question from each unit
All Questions carry **Equal** Marks
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1		A steel tube 2.5 cm external diameter and 1.8 cm internal diameter encloses a copper rod 1.6 cm diameter to which it is rigidly joined at each end. If at a temperature of 10^0C there is no longitudinal stresses calculate the stresses in the rod and the tube when the temperature is raised to 2000^oC. Es=210 kN/mm^2 and Ec=1000 kN/mm^2. Coefficient of linear expansion for steel is 11(10-6)/^{0}C and for copper 18(10-6)/^{0}C	[15M]

Or

2	a)	Deduce the relation between the Modulus of Elasticity and Modulus of Rigidity from fundamentals	[8M]
	b)	A load of 100 N falls through a height of 20 mm on to a collar rigidly attached to the lower end of a vertical bar 1.5 m long and of 1.5 cm^2 cross-sectional area. The upper end of the vertical bar is fixed. Determine: i) Maximum instantaneous stress induced in the bar, and ii) Maximum instantaneous elongation. Take E=2x10^5 N/mm^2	[7M]
3		Draw the S.F and B.M diagrams of the beam shown in figure.	[15M]

Or

4		Draw the SFD and BMD for a cantilever carrying Uniformly Varying Load on the whole span.	[15M]
5		A beam 7 meters long supported at two points equidistant from the ends is loaded with a uniformly distributed load of w Newton per meter run. Calculate the length of the overhang on each side, if the maximum bending moment for the beam has the least value. If the beam is an I – section 100 mm × 250 mm overall, with 20 mm thick flange and web and the maximum bending stress is limited to 120 N/mm^2, find the value of w.	[15M]

Or

6	a)	State the assumptions involved in the theory of simple bending	[8M]
	b)	Derive the section modulus for a box section	[7M]
7		A simply supported beam of span 5 m, carrying a point load of 5 kN at a distance of 3 m from the left end. Find (i) slope at the left support, (ii) deflection under the load and (iii) maximum deflection. Take E= 2x10^5 N/mm^2 and I = 1x10^8 mm^4. Use double integration method.	[15M]

Or

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8 a) Find the slope and deflection of simply supported beam of span L, carrying i) a point load P at the centre, ii) a U.D.L of w kN/m over the entire span using the moment area method. [8M]

    b) Derive an expression for the defection of a cantilever simply supported beam subjected to uniformly distributed load using integration method. [7M]

9   A thin cylinder 70 mm internal diameter, 225mm long with walls 2.3 mm thick is subjected to an internal pressure of 6 MN/m^2. Determine the change in internal diameter and the change in length. If, in addition to the internal pressure, the cylinder is subjected to a torque of 180 N m, find the magnitude and nature of the principal stresses set up in the cylinder. E = 200 GN/m^2. $v = 0.3$ [15M]

Or

10   A thin spherical shell of 1.8m diameter is 10mm thick. It is filled with a liquid so that the internal pressure is 1N/mm^2. Find the increase in diameter and capacity of the shell. Take E = 2 X 10^5 N/mm^2, μ = 0.3 [15M]

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1	a)	A bar of length 20 cm tapers uniformly from 40 mm dia. to 35mm dia. Calculate the change in its length due to an axial pull of 100kN, if E = 200GPa. Derive the formula .	[8M]
	b)	A central steel rod 18 mm diameter passes through a copper sleeve 24 mm inside and 39 mm outside diameter. It is provided with nut and washers at each end, and the nuts are tightened until a stress of 10 N/mm^2 is set up in the steel. The whole assembly is then placed in a lathe and a cut is taken along half the length of the tube removing the copper to a depth of 1.5 mm . Calculate the stress now existing in the steel	[7M]

Or

2	a)	Derive the expression of strain energy for sudden loading.	[7M]
	b)	The Modulus of rigidity for a material is 0.51x10^5 N/mm^2. A 10 mm diameter rod of the material was subjected to an axial pull of 10 kN and the change in diameter was observed to be 3x10^{-3} mm. Calculate Poisson's ratio and the modulus of elasticity.	[8M]
3		Draw the S.F and B.M. diagrams for a simply supported beam carrying a uniformly varying load from zero at left end to w per unit length at the right end.	[15M]

Or

4		Draw the Shear force & Bending moment diagrams for the beam shown in Figure	[15M]
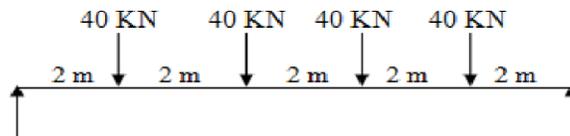
5		A beam of square cross section150 mm is placed in such away that its diagonal is the neutral axis. It is subjected to a shear force of 6 kN. Sketch the variation of shear stress along the depth of the beam.	[15M]

Or

6		Derive the equation M/I = f/y =E/R with sketches	[15M]
7	a)	Write and Explain moment area theorems.	[7M]
	b)	Find the max. slope and deflection of a cantilever beam, when loaded with uniformly distributed load.	

Or

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8　a)　What are the limitations of the moment area method? [7M]

　　b)　A cantilever beam of span 7 m carries a point load of 15 kN at a distance of 4 m [8M]
　　　　from the right end. Compute (a) the slope (b) the deflection under the load (c)
　　　　the maximum deflection and its location. Take $E = 1.5 \times 10^5 \, \text{N/mm}^2$ and $I = 5 \times 10^8 \, \text{mm}^4$.

9　　　A compound cylinder is made by shrinking a cylindrical of external diameter [15M]
　　　　300 mm and internal diameter of 250 mm over an another cylindrical of external
　　　　diameter 250 mm and internal diameter 200 mm. The radial pressure at the
　　　　junction after shrinking is 8 N/mm^2. Find the final stresses sent up across the
　　　　section, when the compound cylinder is subjected to an internal fluid pressure of
　　　　84.5 N/mm^2.

Or

10　　　Derive the Lames equations from the fundamentals in a thick cylindrical shell [15M]
　　　　for the given radii r_1 and r_2 and internal fluid pressure, p. with sketches.

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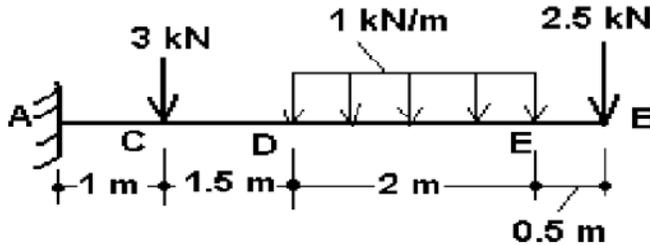(Civil Engineering)

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1	A specimen of steel 28mm diameter with a guage length of 220mm is tested to destruction .It has an extension of 0.16mm under a load of 85kN and the load at elastic limit is 165kN .The maximum load is 180kN.The total extension at fracture is 58mm and diameter at neck is 19mm. Find the (i) stress at elastic limit (ii) Young's modulus (iii) Percentage of elongation (iv) Percentage of reduction in area and (v) Ultimate tensile stress.	[15M]

Or

2	a)	Deduce the Strain Energy expression for impact loading, in terms of Length, L and height of fall h.	[8M]
	b)	A rectangular plate made of steel is 4 m long and 20 mm thick and is subjected to an axial tensile load of 40 kN. The width of the plate varies from 30 mm at one end to 80 mm at the other end. Find the elongation, if $E = 2 \times 10^5$ N/mm^2.	[7M]
3		Draw SFD & BMD for the beam shown in below figure.	[15M]

Or

4	a)	Define the following : i) Bending Moment. ii) Shear force. iii) Point of contra flexure.	[7M]
	b)	A 23 m long cantilever beam is 14 m long. The beam carries a load of 10 KN at 5 m from the fixed end, and a distributed load the intensity of which varies linearly from zero at each end to 6 KN/m at free end. Draw the shear force and bending moment diagrams. Find the magnitude and position of maximum bending moment.	[8M]
5	a)	Define section modulus. Obtain section modulus for rectangular and circular sections.	[8M]
	b)	Write the expression for stresses in terms of section modulus and B.M.	[7M]

Or

6	A beam is of triangular in section having a base "b" and height "h". It is placed with its base horizontal. If at a certain section of the beam, the shear force is "S", find the maximum shear stress and the shear stress at the neutral axis. Sketch the shear stress distribution	[15M]

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7   A simply supported beam is having a span of 8 m. A point load of 48 kN acts on   [15M]
     the beam at a distance of 2 m. from left end. An u.d.l of 10 kN/m also acts over a
     distance of 4 m. from right end. Take E = 200 kN/mm^2 and I = 6.50 x 10^8 mm^4.
     Using Macaulay's method, Find the: (i) Slope at left end.
     (ii) Deflection under point load. (iii) Maximum deflection

                                   Or

8   A simply supported beam 5 m long carries concentrated loads of 10 kN each at   [15M]
     points 1 m from the ends. Calculate:
     (i) Maximum slope and deflection of the beam.
     (ii) Slope and deflection under each load using moment area method

9 a) A steel cylinder 240mm internal diameter is to withstand an internal pressure   [8M]
      of 5N/mm^2. The increase in area of the bore due to the resulting radial
      expansion is limited to 0.1% of the nominal area. Calculate the necessary
      thickness of the cylinder and the circumferential stress induced in the
      section.Take E = 2X10^{5}N/mm^2, μ = 0.3.

   b) A cylindrical shell with internal diameter 60mm and having a thickness equal   [7M]
      to 3 mm is made of mild steel. Determine the permissible internal fluid pressure
      if the factor of safety on maximum shear stress is 4.

                                   Or

10   A cylindrical thin drum 800mm in diameter and 3m. long has a shell thickness of   [15M]
     10mm. If the drum is subjected to an internal pressure of 2.5 N/mm^2, determine
     i) Hoop stress ii) Longitudinal stress iii) Change in diameter iv) Change in
     length v) Change in volume Take E = 2 X 10^5 N/mm^2,
     μ = 0.25.

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SET - 4

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1   Rails of 15 m length were laid on the track when the temperature was 200°C. A   [15M]
    gap of 1.8 mm was kept between two consecutive rails. At what maximum
    temperature the rails will remain stress free ? If the temperature is raised further by
    150°C, what will be the magnitude and nature of stresses induced in the rails? Take
    $\alpha s = 12 \times 10^{-6}$ /°C.

Or

2   a)   A steel rod 100 mm^2 in cross section stretches by 0.4 mm over a gauge length of   [8M]
         50 mm under an axial load of 30 k N. What is the strain – energy stored in it? If
         the load at the elastic-limit is 45 k N, find the elongation at elastic – limit and the
         proof resilience?

    b)   Deduce the relation between Modulus of Elasticity and Modulus of Rigidity from   [7M]
         fundamentals

3   A cantilever beam of length 4m carries an uniformly distributed load of 5KN/m   [15M]
    over a length of 2.5m from its fixed end and a point load 7 KN at its free end.
    Draw the shear force and bending moment diagrams.

Or

4   A simply supported beam AB of span 12 m carries a U.D.L. of 22 N per metre   [15M]
    over 5 metres from L.H support and also over 6 m from the R.H. supports. It has
    also two isolated loads of 20N and 60 N at 3 m and 8 m respectively from the L.H.
    support. Draw the B.M. and S.F diagrams and calculate the B.M. at significant
    points.

5   An I – section beam 350mm × 250mm has a web thickness of 12mm and flange   [15M]
    thickness of 20mm. It carries a shear force of 120KN. Sketch the shear stress
    distribution across the section.

Or

6   A beam consists of a symmetrical rolled steel joist. The beam is simply supported   [15M]
    at its ends and carries a point load at the centre of the span. If the maximum stress
    due to bending is 140 MPa. Find the ratio of the depth of the beam section to span
    in order that the central deflection may not exceed 1/480 of the span. Take E = 200
    GPa.

7   A beam AB of 8 m span is simply supported at the ends and is loaded with point   [15M]
    load 40N at 3m from A and point load of 20N at 2m from B figure. Determine:
    (i)   Deflection at B.
    (ii)   Maximum deflection.
    (iii)   Slope at the end A.
    Given E= 2×10^6N/mm^2 and I = 20×10^{-6} mm^4. Use Macaulay's method.

Or

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8   An overhanging beam is having a span of 5 m. It has one support at its left end and the other support is at a distance of 1 m. from the right end. It carries a point load of 2 kN at a distance of 2 m. from left end and a u.d.l of 1 kN/m acts over a distance of 1 m. from right end. Using Moment-Area method, find the slope and deflection at the right end of the beam.   [15M]

9   A pipe of 400 mm internal diameter and 100mm thickness contains a fluid pressure 80N/mm^2. Find the maximum and minimum hoop stresses across the section, Also sketch the radial and hoop stress distribution across the section.   [15M]

Or

10   A cylindrical drum 420 mm diameter has a thickness of 8mm. If the drum is subjected to an internal pressure of 2.5 N/mm^2, determine the increase in the volume of the drum. Take young's modulus of elasticity, $E=1.6\times10^5$N/mm^2 and poisson's ratio, $\upsilon=0.25$.   [15M]

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