Code No: RT21032 **R13** SET - 1

II B. Tech I Semester Regular/Supplementary Examinations, Oct/Nov - 2016
MECHANICS OF SOLIDS
(Com. to ME, AME, AE, MTE)

Time: 3 hours Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B)**
2. Answer **ALL** the question in **Part-A**
3. Answer any **THREE** Questions from **Part-B**

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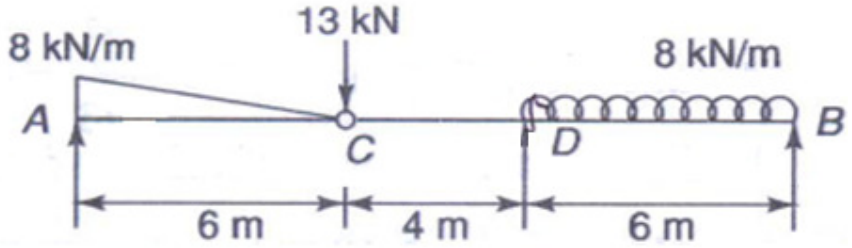
PART –A

1. a) Define and Explain Principal stresses and principal planes?
   b) Derive the Relation between Shear force, Bending Moment and Rate of loading at a section Of a beam
   c) Draw the Shear stress diagrams for I- section and T- section.
   d) A beam 4m long, simply supported at its ends, carries a point load W at its center. If the slope at the beam is not to exceed 1^0 , find the deflection at the center of the beam.
   e) Derive the equations of longitudinal and circumferential stress.
   f) Derive the equation of maximum torque transmitted by a circular solid shaft.
   (3M+3M+4M+4M+4M+4M)

PART-B

2. a) Two vertical rods one of steel and the other of copper are each rigidly fixed at the top and 50cm apart. Diameters and lengths of each rod are 2cm and 4cm respectively. A cross bar fixed to the rods at the lower ends Carries a load of 5000N such that the cross bar remains horizontal even after loading. Find the stress in each rod and position of the load on the bar. Take E_s = 2.x 10^5 N/mm^2, E_c = 1x 10^5 N/mm^2
   b) A round bar of length L and diameter D is subjected to an axial pull *P*. Find the change in volume of the bar. Poisson's ratio = *1/m*, young's modulus = *E*. (8M+8M)

3. a) Draw the sheer force and bending moment diagrams for the beam shown in fig. and also find out the Maximum bending moment and point of contra flexure.



   b) A simply supported beam of length 5m carries a uniformly increasing load of 800N/m run at one end to 1600N/m run at the other end. Draw the sheer force and bending moment diagrams for the beam. Also calculate the position and magnitude of maximum bending moment. (10M+6M)

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4. a) A timber beam 150mm wide and 200mm deep is to be reinforced by bolting on two steel flitches each 150mm by 12.5mm in section. Calculate the moment of resistance in the following cases; (i) flitches attached symmetrically at the top and bottom
(ii) flitches Attached symmetrically at the sides. Allowable stress in timber is 6N/mm^2. What is the maximum stress in the steel in each case? Take E_s = 2x 10^5 N/mm^2, E_t = 1x 10^{4}N/mm^2.

b) A rectangular beam 300mm deep is simply supported over a span of 4m. Determine the U.D.L per meter which the beam may carry, if the bending stress should not exceed 120 N/mm^2. Take I = 8x 10^6 mm^4. (10M+6M)

5. a) Derive the Relation between slope, deflection and radius of curvature.
b) Derive the deflection of a simply supported beam carrying a uniformly distributed load. (10M+6M)

6. a) A thin cylindrical pressure vessel of diameter 2.5m and thickness of 18mm is subjected to an internal pressure of 1.2N/mm^2. In addition, the vessel is also subjected to an axial tensile load of 2800kN. Determine the normal and shear stresses on a plane at an angle of 60^o to the axis of the vessel and also find the maximum shear stress.
b) Find the ratio of thickness to internal diameter for a tube subjected to internal pressure, when the pressure is 5/8 of the maximum permissible circumferential stress. Find the increase in internal diameter of such a tube 100mm internal diameter, when the internal pressure is 90N/mm^2. Take E= 2×10^{5}N/mm^2, and Poisson's ratio= 0.286 (8M+8M)

7. a) A hallow shaft of diameter ratio 3/8 is to transmit 375kW power at 100 rpm. The maximum torque being 20%greater than the mean, the shear stress is not exceed to 60 N/mm^2 and twist in a length of 4 m not to exceed 2^0. Calculate its external and internal diameters which would satisfy both the above conditions. Assume modulus of rigidity G = 0.85x 10^5 N/mm^2.
b) A compression member of 500 mm effective length consists of solid aluminum rod of 25 mm diameter in order to reduce the weight of the member by 25%, the solid rod is replaced by the hallow aluminum rod of 25 mm external diameter. Determine the critical loads for the two members and also find % reduction in the critical load when the hallow member is provided. Take E= 7.28x 10^4 N/mm^2 (8M+8M)

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Code No: RT21032 **R13** SET - 2

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2. Answer **ALL** the question in **Part-A**
3. Answer any **THREE** Questions from **Part-B**

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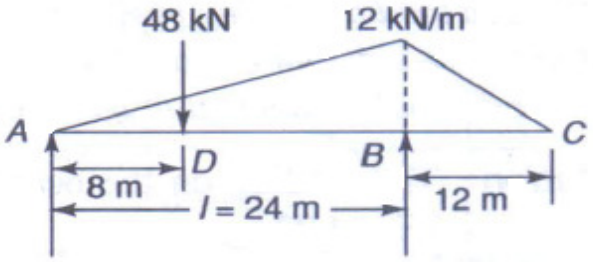
PART –A

1. a) Define Proof resilience and modulus of Resilience?
   b) Define and Explain Shear force and Bending Moment?
   c) Define Pure bending and Write the Assumptions for theory of Simple Bending.
   d) Write the methods of determining Slope and Deflection at a section in a loaded beam
   e) What are the types of stresses in the cylinders? Explain any one of the stress.
   f) Calculate the safe compressive load on a hollow cast iron column of one end is fixed and other hinged of 15 cm external diameter, 10 cm internal diameter and 10 m in length. Use Euler's formula with a factor of safety of 5 and E=95kN/mm^2. (4M+4M+4M+3M+3M+4M)

PART-B

2. a) Derive relation between E & G
   b) Draw Mohr's circle when the component is subjected state of pure shear (8M+8M)

3. a) Draw the shear force and bending moment diagram for given figure. Also find the maximum bending moment and point of contraflexure.



   b) A horizontal beam 10m long is carrying a uniformly distributed load of 1kN/m. The beam is supported on two supports 6m apart. Find the position of the supports, so that bending moment on the beam is as small as possible. Also draw the shear force and bending moment diagrams. (8M+8M)

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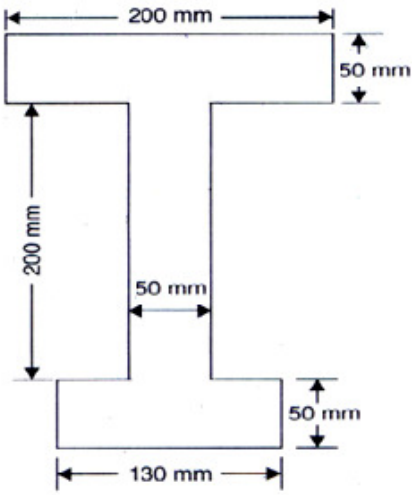
4. a) A beam of cross-section of an isosceles triangle is subjected to a shear force of 30kN at a section where base width=150mm and height=450mm. Determine
   (i) horizontal shear stress at the neutral axis
   (ii) the distance from the top of the beam where shear stress is maximum
   (iii) value of maximum shear stress.
   b) The shear force acting on the beam at an I- section with unequal flanges is 50kN.The section is shown in figure. The moment of inertia of a section about N.A is 2.849×10^4. Calculate the shear stress at the N.A. and also draw the shear stress distribution over the depth of the section. (8M+8M)



5. a) A beam of length 6m is simply supported at its ends and carries two point loads of 48kN at a distance of 1m and 3m respectively from the left support. Find (i) Deflection under each load (ii) Maximum deflection (iii) the point at which maximum deflection occurs. Given $E=2\times10^5$ N/mm^2 and $I=85\times10^6$mm^4.
   b) A horizontal beam of symmetrical section simply supported at the ends, carries a load whose intensity varies uniformly from 18kN/m at one end to 72kN/m at the other. Find the central deflection if the span is 6m, the section is 450mm deep and the maximum bending stress is 90N/mm^2. Take E = 200 kN/mm^2. (8M+8M)

6. a) A shell 3.25m long, 1m in diameter is subjected to an internal pressure of 1N/mm^2. If thickness of the shell is 10mm, find the circumferential and longitudinal stresses. And also find the maximum shell stress and the changes in the dimensions of the shell. Take E = 2×10^5 N/mm^2, 1/m = 0.3.
   b) A riveted boiler 2.25m in diameter has to sustain and internal pressure of 0.56 N/mm^2. The efficiency of the riveted joints is 70% and a safe stress of 60N/mm^{2}is allowed in a material. Find the thickness of the shell and the necessary pitch of rivets for the longitudinal joints, which is a single riveted butt joint. Take diameter of rivet =$6\sqrt{t}$ and where t is thickness of the plate. (10M+6M)

7. a) Determine the diameter of a solid shaft which will transmit 300 kW at 250 rpm. The maximum shear stress should not exceed 30 N/mm^2 and twist should not more than 1^0 in a shaft length of 2 m. Take C = 1x10^{5}N/mm^2
   b) A column of timber section 15cm x 20cm is 6 meters long both ends being fixed. If the young's modulus for Timber = 17.5 kN/mm^2, determine
   (i) Crippling load (ii) Safe load for the column if factor of safety = 3. (8M+8M)

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Code No: RT21032 **R13** SET - 3

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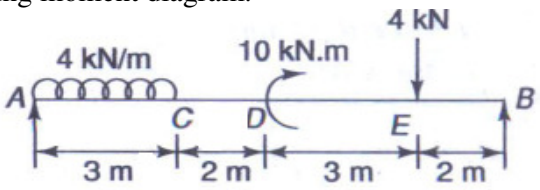
PART – A

1. a) Draw the Stress- Strain diagram for Mild Steel, Cast Iron and Plastic
   b) Define beam? Write classification of beams and loads acting on the beams.
   c) Write the formulas of section modulus for Hollow Rectangular section and Circular section
   d) Determine the slope and deflection of a simply supported beam carrying a point load at the center by MOHR'S theorem.
   e) A water main 80cm diameter contains water at a pressure head of 100m. If the weight density of water is 9810N/m^3, find the thickness of the metal required for the water main. Given the permissible stress as 20 N/mm^2.
   f) What are the assumptions made in the derivation of shear stress produced in a circular shaft Subjected to Torsion? (4M+3M+4M+4M+4M+3M)

PART - B

2. a) A piece of material is subjected to three mutually perpendicular tensile tresses and the strains in the three directions are in the ratio 3:4:5. If the value of Poisson's ratio is0.2857, find the ratio of the stresses and their values when the greatest stress is 90N/mm^2.
   b) Draw Mohr's circle when the component is subjected to state of pure shear. (8M+8M)

3. a) A beam of 10m length is acted upon by forces and a couple as shown in figure. Draw the shear force and bending moment diagram.



   b) A beam of 8m span is hinged at each end. It carries a uniformly distributed load of 2kN/m on the left half of the beam along with a 25kN load at 6m from the left-hand end. In addition the beam is also subjected to couples of 20kNm in counter clockwise direction at left-hand support and 30kNm in the clockwise direction at the right hand support. Determine the reactions at the ends and draw the sheer force and bending moment diagrams indicating the principal values. (8M+8M)

4. a) An I-section beam 350mm×150mm has a web thickness of 10mm and a flange thickness of 20mm. If the shear force acting on the section is 40kN, find the maximum shear stress developed in the section. Sketch the shear stress distribution across the section. Also calculate the total shear force carried by the web.
   b) Derive the expression for the bending stress $M/I = \sigma/y = E/R$. (10M+6M)

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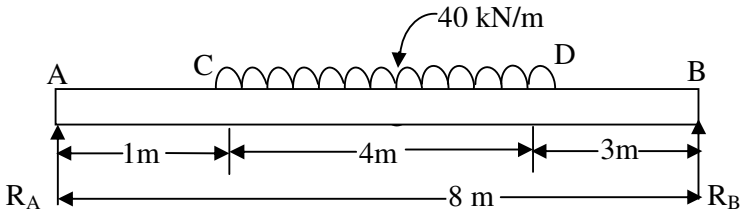
5. a) A beam of length 8m is simply supported at its ends. It carries a uniform distributed load of 40kN/m as shown in figure. Determine the deflection of beam at its mid-point and also the maximum deflection and its position. Take E=2×10^5 N/mm^2 and I=4.3×10^8 mm^4.



b) A horizontal beam AB is simply supported at A and B, 6m apart. The beam is subjected to a clockwise couple of 300kNm at a distance of 4m from the left end. IfE=2×10^5 N/mm^2 and I=2×10^8 mm^4. Determine (i) Deflection at the point where couple is acting
(ii) the maximum deflection. (8M+8M)

6. a) A cylindrical shell 1m long, 180mm internal diameter, thickness of metal 8mm is filled with a fluid at atmospheric pressure. If an additional 20,000mm^3 of the fluid is pumped in to the cylinder. Find the pressure exited by the fluid on the wall of the cylinder and also find the hoop stress is induced take E=2×10^5 N/mm^2 and 1/m = 0.3
b) A thick spherical shell of 100mm internal diameter is subjected to an internal fluid pressure of 30N/mm^2. If Permissible tensile stress is 80N/mm^2 find the thickness of the shell.
(8M+8M)

7. a) A hallow shaft, having an internal diameter 40% of its external diameter transmits 562.5 kW power at 100 rpm. Determine the external diameter of the shaft if the shear stress is not exceed 60N/mm^2 and the twist in a length of 2.5 m should not exceed 1.3 degrees. Assume maximum torque= 1.25 mean torque and C= 9x10^4 N/mm^2
b) Derive an expression for crippling load when one end of the column is fixed and the other end is free. (8M+8M)

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Code No: RT21032 **R13** SET - 4

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2. Answer **ALL** the question in **Part-A**
3. Answer any **THREE** Questions from **Part-B**

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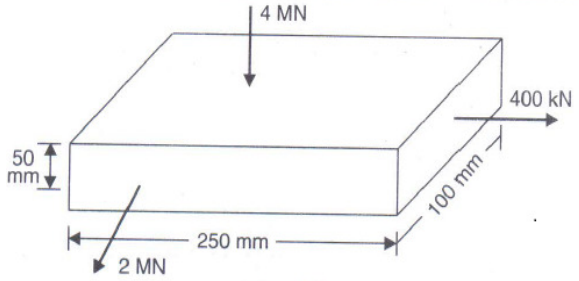
PART –A

1. a) Write the relationship between modulus of elasticity and modulus of rigidity.
   b) Explain Maximum Bending moment and Point of contra flexure.
   c) A rectangular beam 200mm deep and 300mm wide is simply supported over a span of 8m. What Uniform Distributed Load per meter the beam may carry, If the bending stress is not exceed 120 N/mm^2.
   d) Determine the slope and Deflection of a simply supported beam carrying uniformly distributed load by MOHR'S theorem.
   e) A cylindrical shell of thickness 1.5cm has to withstand maximum internal pressure of 1.5N/mm^2. If the ultimate stress in the material of the cylinder is 300N/mm^2, factor of safety 3.0 and joint efficiency 80%, determine the Diameter of the cylinder.
   f) Find the maximum shear stress induced in a solid circular shaft of diameter 15 cm when the shaft transmits 150kW power at 180 r.p.m. (3M+4M+4M+4M+4M+3M)

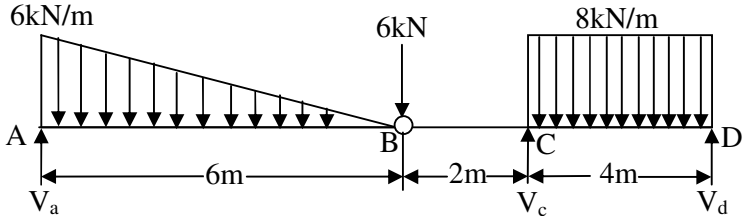
PART-B

2. a) A metallic bar 250mm×100mm×50mm is loaded as shown in fig. find the change in volume. Take $E = 2\times10^5$N/mm^2 and Poisson's ratio= 0.25. Also find the change that should be made in the 4MN load, in order that there should be no change in the volume of the bar.



   b) A bar of steel is length L and the diameter of the bar is varies uniformly from D_1at one end to D_2 at another end. Find the extension of the rod when is carries an axial pull *P*. (8M+8M)

3. a) Analyse the beam ABCD shown in figure. Draw the shear force and bending moment diagram, also calculate the maximum bending moment.



   b) A 20m long girder carrying a U.D.L of W kN/m is to be supported on two piers, 12m apart, in such a way that the maximum bending moment is as small as possible. Determine the distance of piers from the ends of the girder and the maximum bending moment. Draw the sheer force and bending moment diagrams. (8M+8M)

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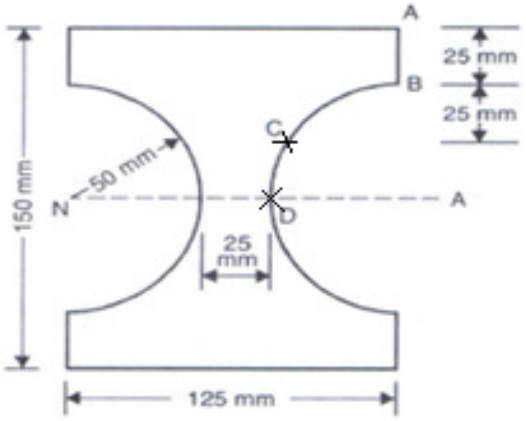
4. a) Figure shows a section, which is subjected to a sheer force of 100kN. Determine the shear stresses at A, B, C, and D. Sketch the shear stress distribution also.



b) A circular beams where one is solid of diameter D and other is a hollow of outer diameter D_0 and inner diameter D_i are f the same length, same material and of same weight. Find the ratio of section modulus of these circular beams (10M+6M)

5. a) Define Macaulay's method? And find out Deflection of a simply supported beam with an Eccentric point load.
b) A horizontal beam of uniform section is pinned at its ends which are the same level and is loaded at the left hand pin with an anti clockwise moment M and right hand pin with a clockwise moment 2M both in the same vertical plane. The length between the pins is L. Find the angles of the slope at each end and the deflection of the midpoint of the span in terms of M, L, E and I. (10M+6M)

6. a) A cylindrical tank 1.8m in diameter and 2.4m long is 12.5mm thick. The ends which are flat and rigid are joined by 9 tie bars of 38mm diameter, and equally spaced. If the tie bar are initially stressed to 45 N/mm^2 and the tank filled with the water determine how much extra water will be pumped in during a pressure test to1.4 N/mm^2 and find the new stress in the tie bar. Neglect any constraint at the junction between the shell and the ends. Take for the tank material and the tie rods $E = 2.06\times10^5$ N/mm^2 and the bulk modulus of water $K = 2060$ N/mm^2.
b) Determine change in dimensions of a thin spherical shell due to an internal pressure. (10M+6M)

7. a) Two shafts of same material and same lengths are subjected to same torque, if the first shaft is a solid circular section and the second shaft is hallow circular section whose internal diameter is 2/3 of the outside diameter. And the maximum shear stress developed in each shaft is the same, compare the weights of the shafts.
b) A simply supported beam of length 4m is subjected to a uniformly distributed load of 30 kN/m over the whole span and deflects 15mm at the center. Determine the Crippling loads when this beam is used as a column with the following conditions.
(i) One end fixed and other end hinged (ii) both the ends pin jointed. (8M+8M)