**II B. Tech I Semester Regular/Supplementary Examinations, Dec - 2015**
**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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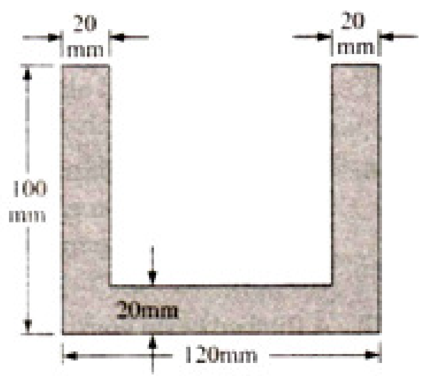
## PART-A

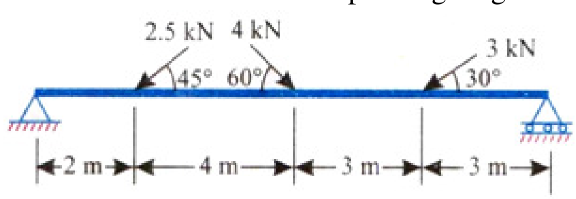
1. a) State and explain hook's law. Draw stress strain diagram.
b) What is point of contra flexure & draw the S.F.D & B.M.D of a cantilever.
c) What are the assumptions considered in theory of simple bending.
d) What are statically indeterminate beams.
e) Differentiate hoop & longitudinal stress.
f) What are the limitations of Euler's formula. (4M+4M+4M+3M+3M+4M)

## PART-B

2. Figure shows a load supported by two copper rods and one steel rod. If the stresses in copper and steel are not to exceed 60 MN/$m^2$ and 120 MN/$m^2$, find the safe load that can be supported. Take $E_s = 2E_c$. (16M)




3. A beam carries loads as shown in Figure. Estimate the maximum bending moment, shearing force and thrust on the beam. Also draw the corresponding diagrams. (16M)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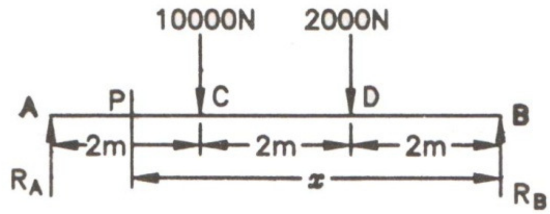
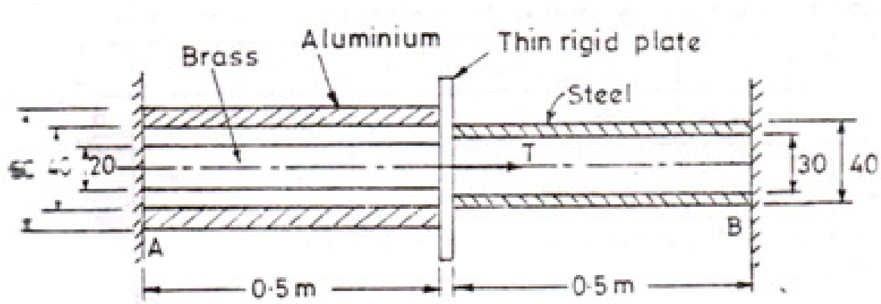
4. A 3 m long rectangular beam of section 100 mm x 200 mm is loaded with a point load of 30000 N distant 1 m from the right hand support. Find the maximum shear stress in the beam. Also find the shearing stress at a layer 20 mm below the top of the beam at a section 1 m to the right of the left hand support. (16M)

5. A simply supported beam is loaded as shown in the figure below. Calculate the deflection at the load points. Take $E = 2 \times 10^7$ N/cm$^2$ and $I = 20000$ cm$^4$. (16M)




6. a) Derive the change in dimensions of a thin cylindrical shell due to internal pressure.
   b) The internal diameter of a cylindrical shell is 1 m and its length is 3 m, the plates being 1.5 cm thick. Determine the circumferential and longitudinal stresses set up and the changes in dimensions of the shell when a fluid is introduced in it at a pressure of 1.5 N/mm$^2$. Take $E = 200$ kN/mm$^2$ and $1/m = 0.3$. (16M)

7. A torque T = 5 kN.m is applied to the composite shaft shown in Figure through a rigid plate. Calculate the maximum shearing stress in each material. $G_s = 84$ GPa, $G_a = 28$ GPa, $G_b = 40$ GPa. Outside & Inside diameter of aluminium is 60 and 40mm respectively. (16M)



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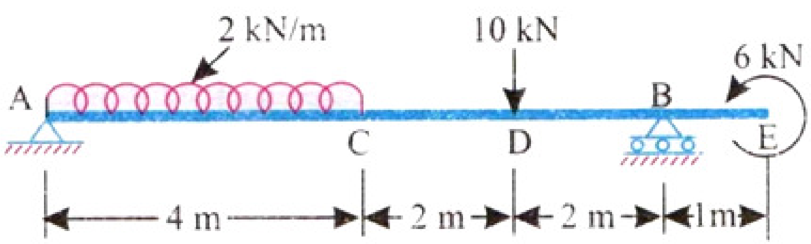
## PART-A

1. a) Derive the total elongation of the bar rigidly fixed at one end and is strained due to self weight.
   b) Draw the S.F.D & B.M.D for a cantilever beam loaded at the free end.
   c) What parameters can be varied to achieve the beams of uniform strength.
   d) Briefly describe the procedure of Macaulay's method.
   e) A thin cylindrical shell of diameter 300 mm and wall thickness 6 mm has hemispherical ends. If there is no distortion of the junction under pressure determine the thickness of hemispherical ends.
   f) What is modulus of rupture. (4M+4M+3M+4M+4M+3M)

## PART-B

2. A compound bar consists of a central steel strip 25 mm wide and 6.4 mm thick placed between two strips of brass each 25 mm wide and $x$ mm thick. The strips are firmly fixed together to form a compound bar of rectangular section 25 mm wide and $(2x + 6.4)$ mm thick. Determine:
   i) The thickness of the brass strips which will make the apparent modulus of elasticity of compound bar 157 GN/m$^2$.
   ii) The maximum axial pull the bar can then carry if the stress is not to exceed 157 MN/m$^2$, in either the brass or the steel. Take $E_s$ = 207 GN/m$^2$ and $E_b$ = 114 GN/m$^2$. (16M)

3. Draw shear force and bending moment diagrams for the beam shown in Figure. Show all important values. (16M)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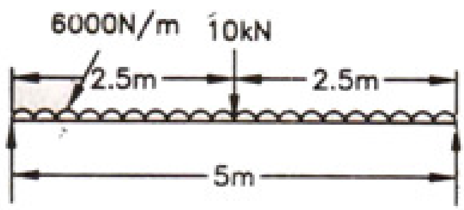
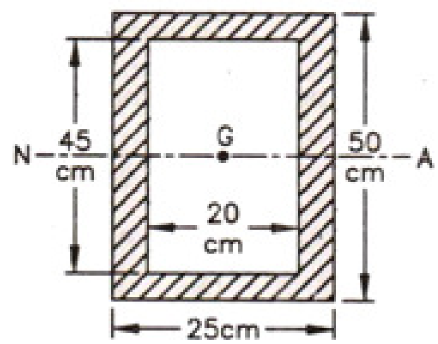
4. An I-section beam of flanges 20 cm x 2 cm and web 30 cm x 1 cm is acted on by a shearing force of 150 kN. Determine:
   i) The maximum and minimum shearing stress in the web.
   ii) The maximum shear stress in the flange.
   iii) The shearing stress at a layer 6 cm below the top of the section. Show the above stresses in the stress distribution diagram. (16M)

5. The cross-section of a simply supported beam 5 m long consists of a hollow rectangular box as shown in the figure below. The beam is loaded with a U.D.L. of 6000 N/m over its entire length and a point load of 10 kN at its centre. If $E = 2 \times 10^7$ N/cm$^2$, determine:
   i) Maximum bending stress ii) The maximum deflection and
   iii) Maximum slope and state the locations where they occur. (16M)




6. A cylindrical vessel whose ends are closed by means of rigid flange plates is made of steel plate 3 mm thick. The internal length and diameter of vessel are 50 cm and 25 cm respectively. Determine the longitudinal and circumferential stresses in the cylindrical shell due to an internal fluid pressure of 3 MN/m$^2$. Also calculate increase in length, diameter and volume of the vessel.
   Take: E = 200 GN/m$^2$, and $\frac{1}{m} = 0.3$. (16M)

7. A gun metal sleeve is securely fixed to a steel shaft and the compound shaft is subjected to a torque. Find the ratio of the external diameter of the sleeve to the diameter of the shaft if the torque on the sleeve is three times the torque on the shaft. If the maximum allowable shear stresses in the gun metal and steel are 40 and 70 MPa respectively, determine the torque that may be transmitted by the compound tube when the shaft diameter is 5 cm..$G_{steel}$=80GPa and $G_{gunmetal}$=30GPa. (16M)

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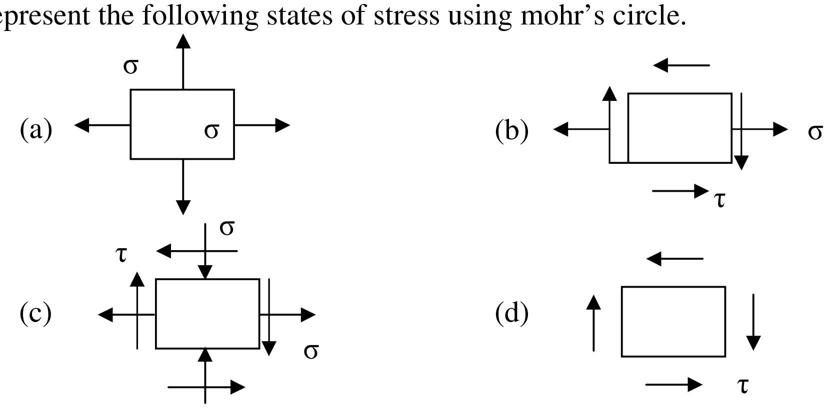
## PART-A

1. a) Derive the relation between E & K.
   b) Classify the types of beams.
   c) Find the moment of resistance by the "economics section" equation.
   d) Briefly describe the procedure of double integration method.
   e) Calculate the bursting pressure for a cold drawn seamless steel tubing of 60 mm inside diameter with 2 mm wall thickness. The ultimate strength of steel is 380 $MN/m^2$.
   f) What is the importance of angle of twist and various stress in shaft.

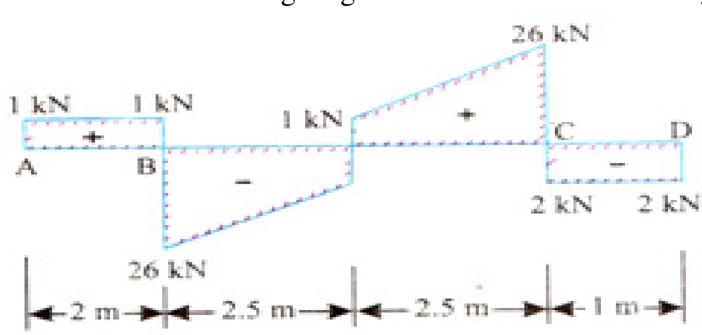
(4M+3M+4M+4M+4M+3M)

## PART-B

2. Represent the following states of stress using mohr's circle. (16M)




3. Figure shows the S.F. diagram for a beam ABCD having overhangs at both the supports. From the S.F.D. deduce the loading diagram. Draw the B.M.D. stating the principal values. (16M)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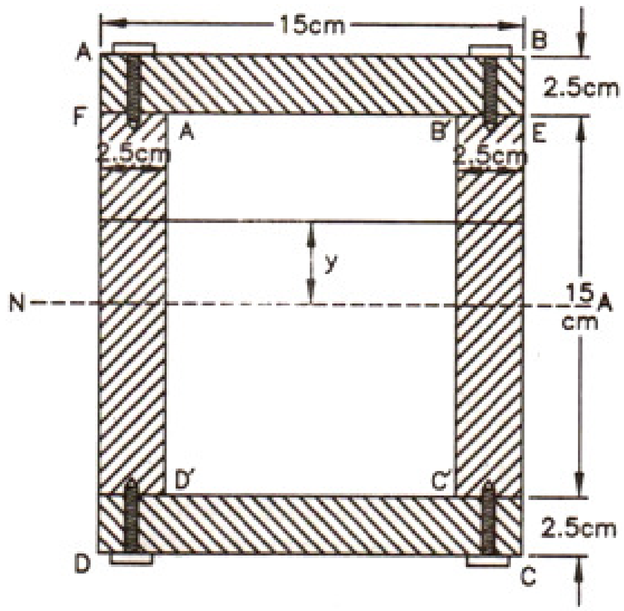
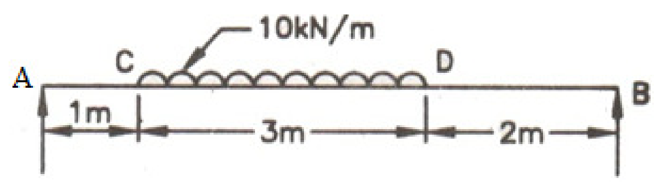
4. The box section shown in the following figure is made up of four 15 cm × 2.5 cm planks joined by screws. Each screw can safely transmit a shear force of 1250 N. Estimate the maximum necessary spacing of screw along the length of the beam if the maximum shear force transmitted by the cross-section is 5000 N. Sketch the corresponding shear stress distribution across the cross-section. (16M)




5. A simply supported beam is loaded with uniformly distributed load of 10 kN/m as shown in the figure below. If flexural rigidity EI = 45000 kN/m$^2$, determine the central deflection and maximum deflection and the location of its occurrence. (16M)




6. A cylindrical made of bronze 120 mm outside diameter and 10 mm thick is strengthened by a single layer of steel wire, 1.5 mm diameter, wound over it under a constant stress of 50 MN/m$^2$. The cylinder is subjected to an internal pressure of 18MN/m$^2$ with rise in temperature of cylinder by 80$^o$C. Assuming the cylinder to be a thin shell with closed ends, determine the final values of:
   i) The stress in the wire; ii) The circumferential stress in the cylinder wall;
   iii) The radial pressure between the wire and the cylinder. (16M)

7. Derive the equivalent length of column fixed at one end and hinged at the other. (16M)

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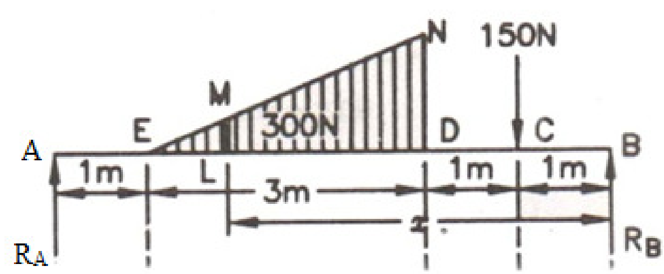
## PART-A

1. a) Draw and frame the stresses obtained in Mohr's circle for like stresses.
   b) Draw the S.F.D & B.M.D for a cantilever with uniformly distributed load.
   c) Show that max shear stress is 3/2 of mean shear stress in rectangular section.
   d) Briefly describe the procedure of moment area method.
   e) Which ratio decides whether cylinder is thin or thick.
   f) Define torsional rigidity & power transmitted by shaft. (4M+4M+4M+4M+3M+3M)

## PART-B

2. A rectangular block of material is subjected to a tensile stress of 100 $MN/m^2$ on one plane and a tensile stress of 50 $MN/m^2$ on a plane at right angles, together with the shear stresses of 60 $MN/m^2$ on the same planes. Find:
   i) The magnitude of the principal stresses. ii) The directions of the principal planes.
   iii) The magnitude of the greatest shear stress. (16M)

3. Compute the values of maximum and minimum B.M. and S.F. for the simply supported beam loaded as shown below. Draw the B.M. and S.F. diagrams indicating the significant values. (16M)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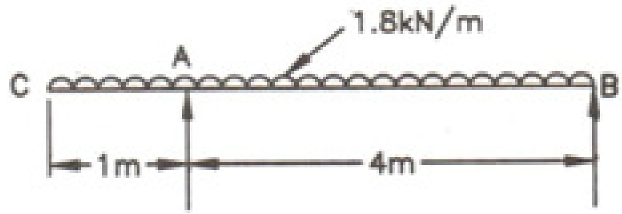
4. Show that in a circular section, maximum shear stress is 4/3 times the average shear stress. (16M)

5. Find the deflection of a rectangular beam 10 cm X 6 cm at the free end C shown as below. Take E = $10^4$ kN/$cm^2$. (16M)




6. A compound cylinder is formed by shrinking one cylinder on to another, the final dimensions being internal diameter 120 mm, external diameter 240 mm and diameter at junction 200 mm. After shrinking on the radial pressure at the common surface is 10 MN/$m^2$.
Calculate the necessary difference in diameters of the two cylinders at the common surface.
What is the minimum temperature through which outer cylinder should be heated before it can be slipped on. Take: E = 200 GN/$m^2$, and $\alpha$ = 0.000011 per $^0$C. (16M)

7. A solid round bar 6 cm in diameter and 2.5 m long is used as a strut. One end of the strut is fixed while its other end is hinged. Find the safe compressive load for this strut using Euler's formula. Assume E = 200 GPa and factor of safety = 3. (16M)