Code No: R21011 **R10** SET - 1

II B. Tech I Semester Regular Examinations, March – 2014
MECHANICS OF MATERIALS
(Civil Engineering)

Time: 3 hours Max. Marks: 75

Answer any **FIVE** Questions
All Questions carry **Equal** Marks
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1. a) Four forces of magnitude P, 2P, 5.196P and 4P are acting at a point O. The angles made by these forces with x-axis are 0^0, 60^0, 150^0 and 300^0 respectively. Find the magnitude and direction of the resultant force.
   b) Four forces of magnitude 10 kN, 20 kN, 30 kN and 40 kN are acting respectively along the four sides of a square ABCD as shown in Figure 1. Determine: i) the resultant force, line of action and its direction. ii) Determine the resultant moment about point A. (7M+8M)

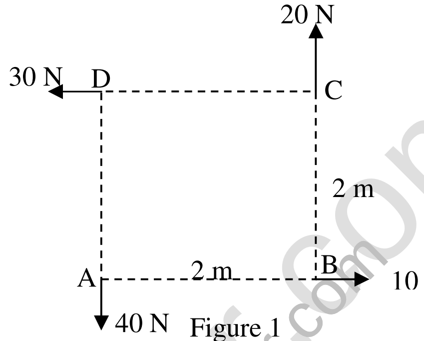

Figure 1

2. a) A ladder 5 m long and of 250 N weight is placed against a vertical wall in a position where its inclination to the vertical is 30^0. A man weighing 800 N climbs the ladder. At what position will he induce slipping? The coefficient of friction for both the contact surfaces of the ladder viz. with the wall and the floor is 0.2.
   b) Two locomotives on opposite banks of a canal pull a vessel moving parallel to the banks by means of two horizontal ropes. The tensions in the ropes are 2000 N and 2400 N while angle between them is 60^0. Find the resultant pull on the vessel and the angle between each of the ropes and the sides of the canal. (8M+7M)

3. a) Show that the maximum power can be transmitted at $\tau_{max} = 3\,\tau_c$
   b) A shaft rotating at 200 r.p.m drives another shaft at 300 r.p.m and transmits 6KW through a belt, the belt is 100mm wide and 10mm thick. The distance between the shafts is 4000mm the smaller pulley is 500mm in diameter. Calculate the stress in,
   (i) Open - belt and (ii) Crossed belt. Take $\mu = 0.3$. Neglect centrifugal tension. (7M+8M)

4. a) Find out the mass moment inertia of a right circular cone of base radius, **R,** and mass, **M,** bout the axis of the cone.
   b) Find the moment of inertia about the horizontal centriodal axis of shaded portion for the Figure 2. (8M+7M)

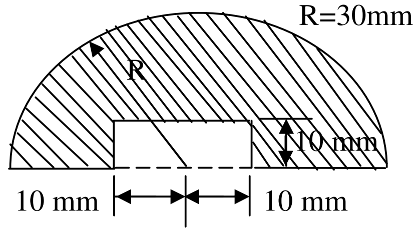

Figure 2
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Code No: R21011 **R10** SET - 1

5. a) Explain the terms:
   i) Modulus of elasticity *ii*) Modulus of rigidity and *iii*) Bulk modulus.

   b) Show that in a compound bar of length *L*, when temperature increases by *t*, the force '*P*' developed is given by

$$\frac{PL}{A_1E_1}+\frac{PL}{A_2E_2}=(a_1-a_2)tL$$

   Where A_1, A_2–Cross-sectional areas of bar 1 and bar 2 respectively
   E_1, E_2–Young's moduli of bar 1 and bar 2 respectively and α_1 and α_2 are coefficient of thermal expansion of bars 1 and 2 respectively. (6M+9M)

6. Draw BM and SF diagrams for the beam shown in Figure 3, indicating the values at all salient points. (15M)

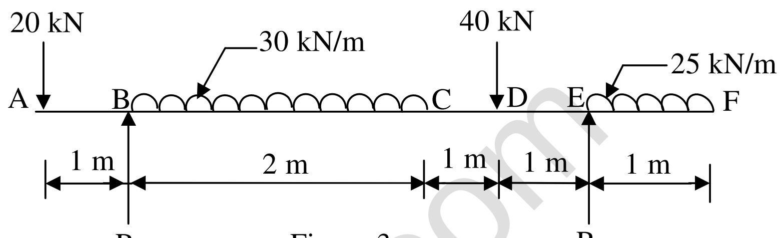

Figure 3

7. a) Compute the section modulus of rectangular section of dimensions ***b*** x ***d***.

   b) A simply supported beam of span 5.0 m has a cross-section 230 mm × 350 mm. If the permissible stress in the material of the beam is 10 N/mm^2, determine
   i) maximum uniformly distributed load it can carry
   ii) maximum concentrated load at a point 1 m from support it can carry.
   Neglect moment due to self weight. (6M+9M)

8. A beam has cross-section as shown in Figure 4. If the shear force acting on this is 150 kN, Draw the shear stress distribution diagram across the depth. (15M)

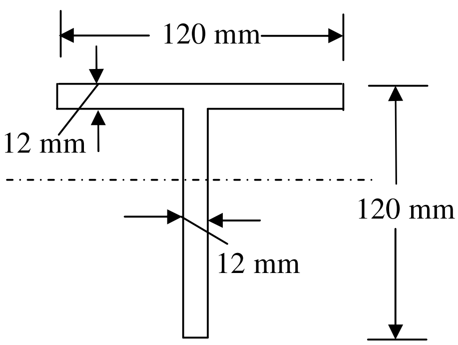

Figure 4

Code No: R21011 **R10** SET - 2

II B. Tech I Semester Regular Examinations, March – 2014
MECHANICS OF MATERIALS
(Civil Engineering)

Time: 3 hours Max. Marks: 75

Answer any **FIVE** Questions
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1. Find the resultant of the concurrent force system shown in Figure 1 which consists of the forces T = 500 N, P = 250 N and F = 800 N directed from D towards A, B and C respectively. (15M)

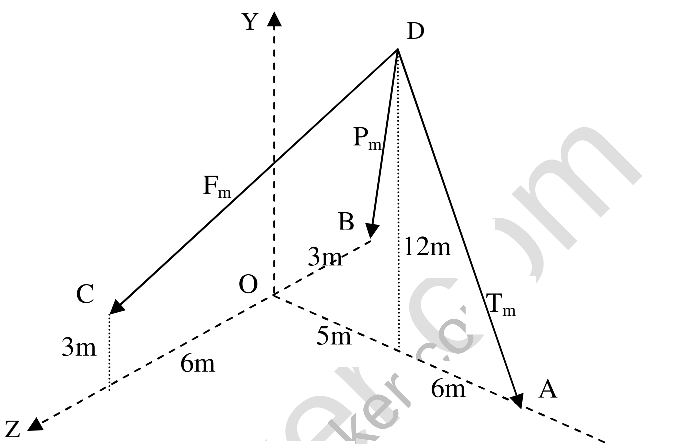

Figure 1

2. a) Explain the principles of operation of a screw-jack with a neat sketch.
   b) Outside diameter of a square threaded spindle of a screw Jack is 40mm. The screw pitch is 10mm. If the coefficient of friction between the screw and the nut is 0.15, neglecting friction between the nut and collar, determine
   i) Force required to be applied at the screw to raise a load of 2000N
   ii) The efficiency of screw jack
   iii) Force required to be applied at pitch radius to lower the same load of 2000N
   iv) Efficiency while lowering the load
   v) What should be the pitch for the maximum efficiency of the screw and what should be the value of the maximum efficiency. (6M+9M)

3. A leather belt is required to transmit 9kW from a pulley 1200 mm in diameter running at 200 r.p.m The angle embraced is 1650 and the coefficient of friction between leather belt and pulley is 0.3. If the safe working stress for the leather belt is 1.4N/mm^2 the weight of leather is 1000Kg/m^3 and the thickness of the belt is 10mm, determine the width of the belt taking the centrifugal tension in to account. (15M)
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Code No: R21011 **R10** SET - 2

4. a) Determine the volume generated by the shaded area as shown in Figure 2 about X –axis

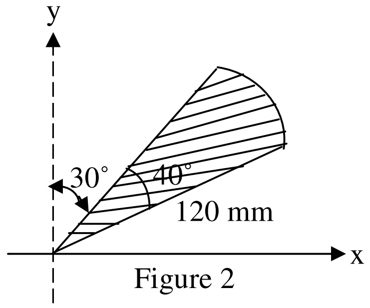

Figure 2

b) Show that the moment of inertia of a thin circular ring of mass ‘M’ and mean radius R with respect to its geometric axis is MR^2. (7M+8M)

5. a) If the Poisson’s ratio of a material is 0.3 and its young’s modulus is 2.1×10^5 N/mm^2. What is the value of shear modulus?

b) A steel rod of 20 mm diameter passes centrally through a tight copper tube of external diameter 40 mm. The tube is closed with the help of the rigid washers of negligible thickness and nuts threaded on the rod. The nuts are tightened till the compressive load on the tube is 50kN. Determine the stresses in the rod and the tube, when the temperature of the assembly falls by 50^{0}C. Take E_s = 200 GN/mm^2, E_c = 100 GN/mm^2, $\alpha_s = 12 \times 10^{-6}$ per ^{0}C, $\alpha_c = 18 \times 10^{-6}$ per ^{0}C. (6M+9M)

6. The simply supported beam AD is subjected to a uniform load over the segment BC together with a concentrated force applied at C as shown in Fig.3 Draw Shear force and bending moment diagram and indicate the values at salient points. (15M)

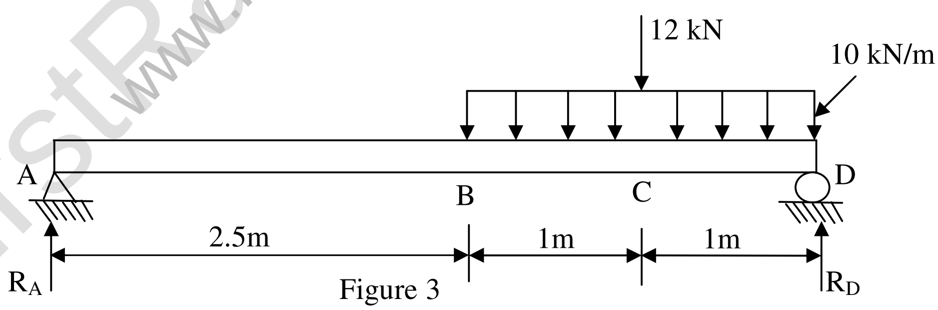

Figure 3

Code No: R21011 R10 SET - 2

7. The cross-section of a cast iron beam is as shown in Figure 4. The top flange is in compression and bottom flange is in tension. Permissible stress in tension is 30 N/mm^2 and its value in compression is 90 N/mm^2. What is the maximum uniformly distributed load the beam can carry over a simply supported span of 5 m? (15M)

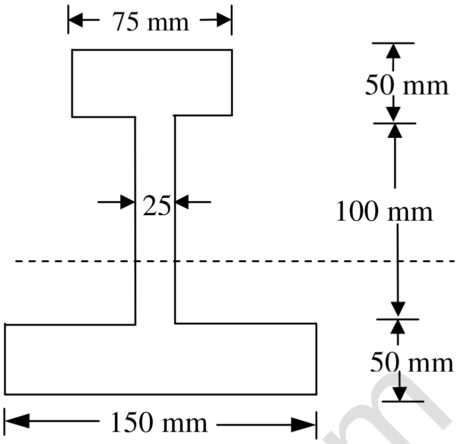

Figure 4

8. A ***I***-Section has flanges of size 200 × 12 mm and its overall depth is 360 mm. The thickness of the web is also 12 mm. It is used as a simply supported beam over a span of 4 m to carry a load of 60 kN/m over its entire span. Draw the variation of bending and shearing stresses across the depth. (15M)

Code No: R21011 **R10** SET - 3

II B. Tech I Semester Regular Examinations, March – 2014
MECHANICS OF MATERIALS
(Civil Engineering)

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Answer any **FIVE** Questions
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1. a) Three identical cylinders, each of weighing W, are staked as shown in Figure 1, on smooth inclined surfaces, each inclined at an angle, 'θ' with the horizontal. Determine the smallest angle 'θ' to prevent stack from collapsing.
   b) The boom of crane is shown in Figure 2, if the weight of the boom is negligible compared with the load W = 60 kN, find the compression in the boom and also limiting value of tension 'T' when the boom approaches the vertical position. (7M+8M)

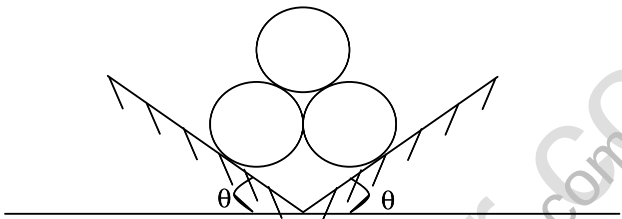

Figure 1

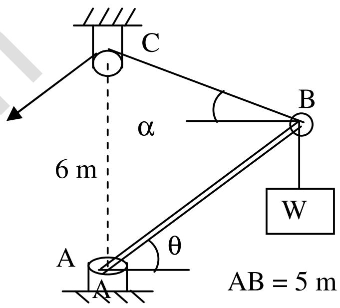

Figure 2

2. a) Find the least horizontal force 'P' to start motion of any part of the system of three blocks resting upon one another as shown in figure 3. The weights of the blocks are A =300N, B = 1000 N, C = 2000 N. Between A and B, μ = 0.3, between B and C, μ = 0.2 and between C and the ground μ = 0.1.
   b) Define the following terms
      i) Friction; ii) Angle of friction; iii) Cone of Friction
   c) What are the characteristic of friction? (6M+6M+3M)

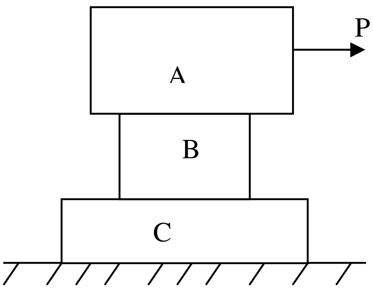

Figure 3
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Code No: R21011 **R10** SET - 3

3. a) Distinguish between quarter turn and compound belt drives.
   b) Determine the maximum power that can transmitted using a belt of 100 mm × 10 mm with an angle of lap of 1600 . The density of belt is 1000kg/m^3 and coefficient of friction may be taken as 0.25. The tension in the belt should not exceed 1.5N/mm^2. (6M+9M)

4. a) A thin plate of mass 'm' is cut in the shape of a parallelogram of thickness, 't' as shown in Figure 4. Determine the mass moment of inertia of the plate about the x-axis.
   b) Determine the centriod for a semicircular arc about its diametral base. (7M+8M)

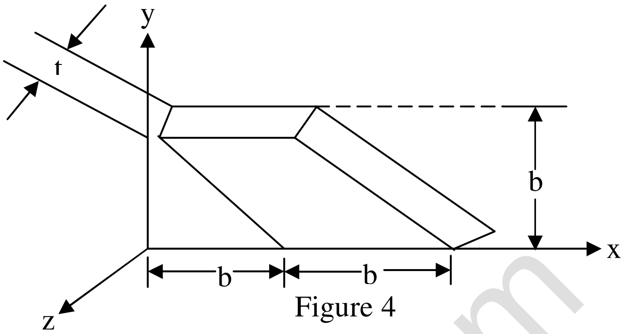


Figure 4

5. a) A bar of uniform thickness '*t*' tapers uniformly from a width ***b*1** at one end to ***b*2** at the other end in a length ***L***. Find the expression for its extension under an axial pull *P*.
   b) Tension test was conducted on a specimen and the following readings were recorded.
   Diameter = 25 mm
   Gauge length of extensometer = 200 mm
   Least count of extensometer = 0.001 mm
   At a load of 30 kN, extensometer reading = 60
   At a load of 50 kN, extensometer reading = 100
   Yield load = 160 kN
   Maximum load = 205 kN
   Diameter neck = 17 mm
   Final extension over 125 mm original length = 150 mm
   Find Young's Modulus, yield stress, ultimate stress, percentage elongation and percentage reduction in area. (7M+8M)

6. The Beam AC is simply supported at A and C and subjected to the uniformly distributed load of 300 N/m plus the couple of magnitude 2700 N-m as shown in Figure 5 Write equations for shearing force and bending moment and make plots of these equations. (15M)

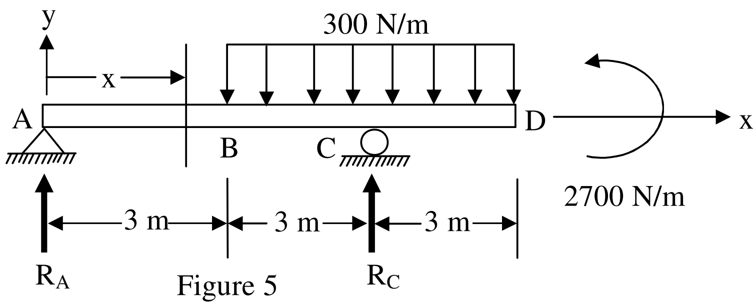


Figure 5

Code No: R21011 **R10** SET - 3

7. The cross-section of a cast iron beam is as shown in Figure 6. The top flange is in compression and bottom flange is in tension. Permissible stress in tension is 30 N/mm^2 and its value in compression is 90 N/mm^2. What is the maximum uniformly distributed load the beam can carry over a simply supported span of 5 m? (15M)

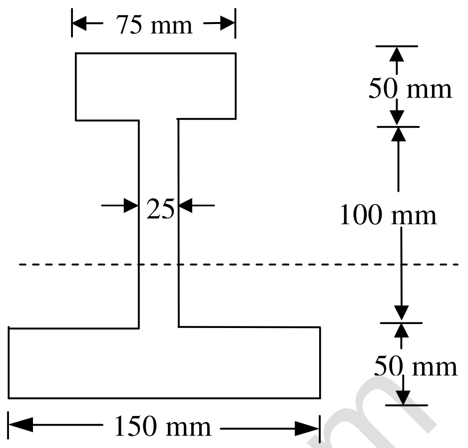
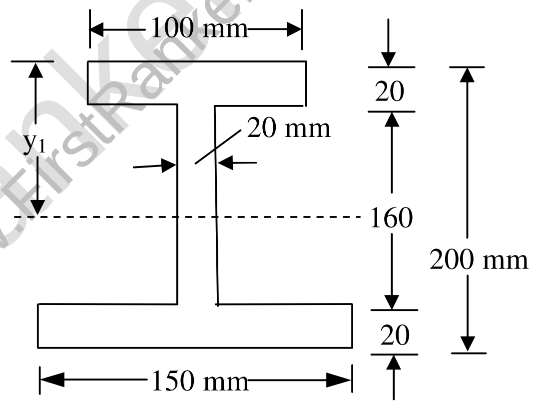


Figure 6

8. The unsymmetrical ***I***-section shown in Figure 7 Is the cross section of a beam, which is subjected to a hear force of 60 kN. Draw the shear stress variation diagram across the depth. (15M)



(a)
Figure 7

Code No: R21011 **R10** SET - 4

II B. Tech I Semester Regular Examinations, March – 2014
MECHANICS OF MATERIALS
(Civil Engineering)

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1. a) A tripod consists of three bars joined at D as shown in Fig.1. Find the component of force F along the direction T and the angle between F & T.
   b) Compute the horizontal component and its direction from X axis of resultant force of the force system T = 400 N, P = 200 N and F = 650 N directed from D towards A,B and C respectively acting as shown in Figure 1. (8M+7M)

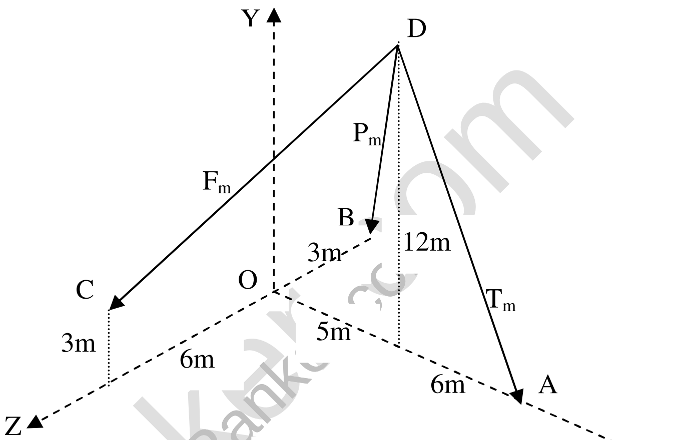

Figure 1

2. Two smooth ball bearings each of weight ‘w’ and radius ‘r’ are placed inside a cylindrical open at both ends. The assembly rests on a horizontal surface as shown in Figure 2. If the cylinder is of weight ‘W’ and radius R < 2r, find: a) the force exerted by either ball bearing on the cylinder, b) the smallest value of W that will prevent the cylinder from tipping over c) could the cylinder possibly tip if it were closed at the bottom? (15M)

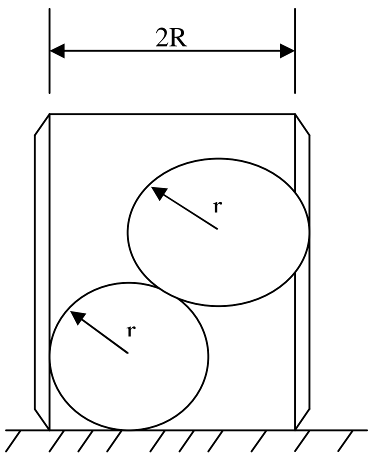

Figure 2
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3. a) Deduce an expression for centrifugal tension of belt drive.
   b) The maximum allowed tension in a belt is 1500 N. The angle of lap is 170^0 and coefficient of friction between the belt and material of the pulley is 0.27. Neglecting the effect of centrifugal tension, calculate the net driving tension and power transmitted if the belt speed is 2 m/s. (7M+8M)

4. a) Determine the product of inertia of shaded area as shown in Figure 3 about the x-y axis.
   b) Define mass moment of inertia and explain Transfer formula for mass moments of inertia. (7M+8M)

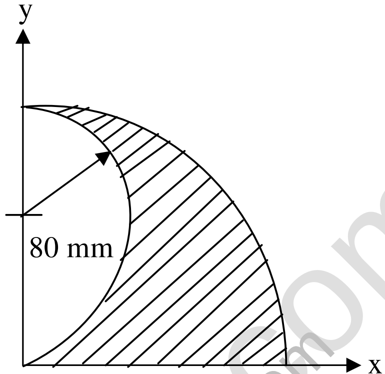

Figure 3

5. a) A tapering rod has diameter $\boldsymbol{d_1}$ at one end and it tapers uniformly to a diameter $\boldsymbol{d2}$ at the other end in a length $\boldsymbol{L}$. If the modulus of elasticity is E, find the change in length when subjected to an axial force P.
   b) Derive the relationship between
      i) Modulus of elasticity and modulus of rigidity
      ii) Modulus of elasticity and bulk modulus. (7M+8M)

6. Draw the bending moment and shear force diagram for the beam loaded as shown in Figure 4. Mark the values at the salient points. Determine the point of contraflexure also. (15M)

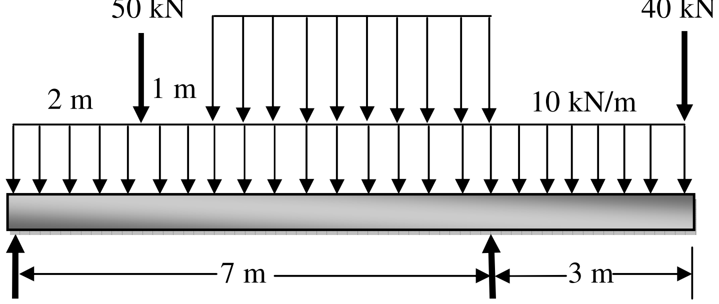

Figure 4

Code No: R21011 **R10** SET - 4

7. A symmetric I-section of size 200mm × 500mm, 15 mm thick is strengthened with 300mm ×20 mm rectangular plate on top flange as shown is Figure 5. If permissible stress in the material is 150 N/mm^2, determine how much concentrated load the beam of this section can carry at centre of 6 m span. Given ends of beam are simply supported. (15M)

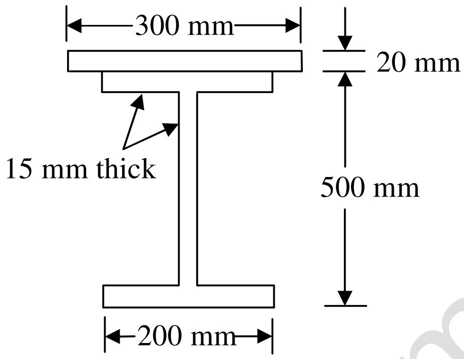

Figure 5

8. a) Derive the expression for shear stress distribution of a rectangular section.
   b) For a circular section of a diameter D. determine formula of shear stress at a distance ‘a’ from neutral axis at a section of a beam where shearing force is F. Hence find the ratio of shear stresses, q_{max} to $q_{average}$. (7M+8M)