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

II B. Tech I Semester Supplementary Examinations, June - 2015
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) A horizontal line PQRS is 12 m long, where PQ = QR = RS = 4m. Forces of 1000, 1500, 1000 and 500 N act at P, Q, R and S respectively and action of these forces make angles of 90^0, 60^0, $45^0$and 30^0 respectively with PS. Find the magnitude, direction and position of the resultant force. [8]

b) A force of 100 N is acting at a point A as shown in figure 1. Determine the moments of this force about O. [7]

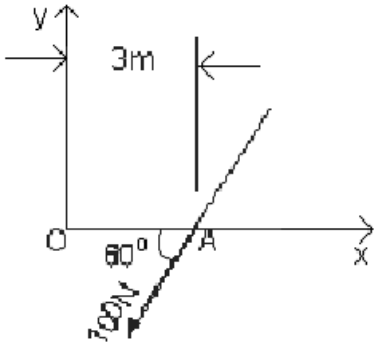

Fig.1

2 A body resting on a rough horizontal plane required to pull of 180 N inclined at 30^0 to the plane just moved the body. Determine the weight of the body and the coefficient of friction. 15

3 A cross belt drive is to transmit 7.5 KW at 1000 r.p.m of the smaller pulley. The diameter of the smallest pulley is 250mm and velocity ratio is 2. The centre distance between the pulley is 1250mm. A flat belt of thickness 6mm and of coefficient friction 0.3 is used over the pulleys. Determine the necessary width of the belt if the maximum allowable stress in the belt is $1.75N/mm^2$ and density of the belt is $1000Kg/m^3$. 15
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4 a) Find the coordinates of centroid of shaded area as shown in below figure 2. All dimensions are in cm. 8

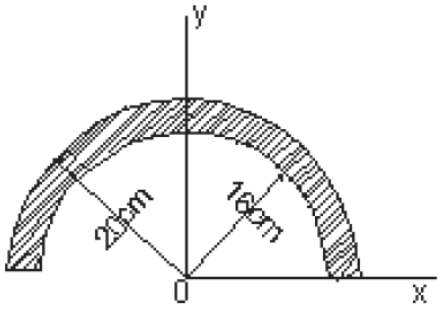

Fig.2

b) Find out the mass moment of inertia of a right circular cone of base radius R and mass M about the axis of the cone. 7

5 Two vertical rods one of steel and the other of copper are rigidly fastened at their upper end at a horizontal distance of 200 mm as shown in fig.3. The lower ends support a rigid horizontal bar, which carries a load of 10 KN. Both the rods are 2.5 m long and have cross sectional area of 12.5 mm^2. Where a load of 10 KN should be placed on the bar. So that it remains horizontal after loading. Also find the stress in each rod. Take E_s = 200 GPa and E_c = 110 GPa. Neglect the bending of the cross bar. 8

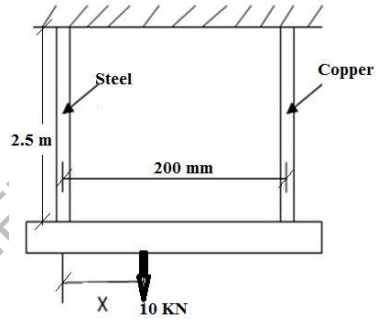

Fig.3

b) Deduce the relation for stress in case of impact loading. 7

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6 Draw the shear force and bending moment diagrams for the beam shown in Fig.4 15

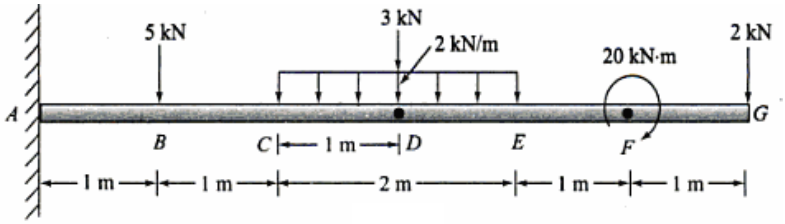

Fig.4 12

7 A simply supported beam of span 6m and of I section has the top flange 40 mm x 5 mm, bottom flange of 60 mm x 5 mm, total depth of 100 mm, and web thickness 5 mm. It carries an UDL of 2kN/m over the full span. Calculate the maximum tensile stress and Maximum compressive stress produced. 15

8 The shear force acting on a T section of a beam is 50 kN as shown in Figure 5. Calculate the shear stress at the neutral axis and at the junction of the web and the flange and draw stress variation. 15

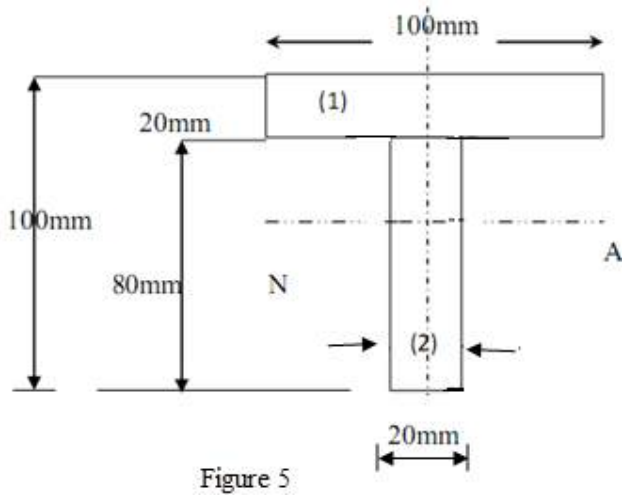

Figure 5

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1 a) Four forces equal to P, 2P, 3P and 4P are acting along the four sides of a square ABCD respectively taken in order. Side = 40 mm. Find the magnitude, direction and position of the resultant force. [8]

b) Four forces of magnitude 10 N, 20 N, 30 N and 40 N are acting respectively along the four sides of a square ABCD as shown in figure 2. Determine the resultant moment about the point A. Each side of the square is given as 2m.

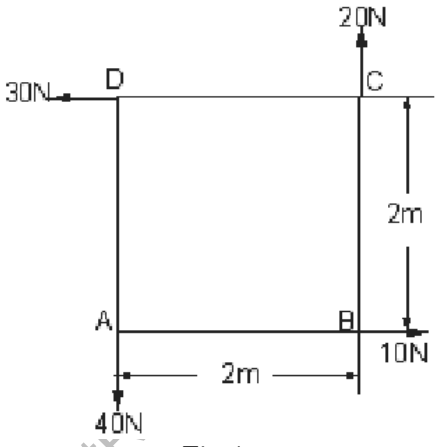

Fig.1

[7]

2 a) The mean diameter of the threads of a square – threaded screw is 50 mm. The pitch of the thread is 6 mm. The coefficient of friction μ = 0.15. What force must be applied at the end of a 600 mm lever, which is perpendicular to the longitudinal axis of the screw to raise a load of 17.5 kN? To lower the load. 8

b) A wooden block weighing 30 N is placed on a horizontal plane. A horizontal force of 12 N is applied and the block is on the point of moving. Find
i. Coefficient of friction
ii. Angle of friction and
iii. The resultant reaction.

7

3 A shaft rotating at 200 r.p.m. transmits 6 kW through a belt. The belt is 100 mm wide and 10 mm thick. The distance between the shafts is 4 m. The smaller pulley is 0.5 m in diameter. Calculate the stress in the belt, if it is a cross belt drive. Take μ = 0.3.

15
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4 a) Differentiate centroid, centre of gravity and mass centre. 6

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. 9

5 A steel flat 24 mm x 6 mm in section riveted between two aluminum flats of same size at a temperature of 288 K is shown in fig 2. If this assembly is subjected to a compressive force of 35kN, find the stresses developed in each material. To what temperature the assembly can be raised that the stresses in the materials due to the load are nullified. $E_s = E_{A1} = 210$ GPa. $\alpha_s = 12x10^{-6}$ /K and $\alpha_{Al} = 23 \times 10^{-6}$/K.

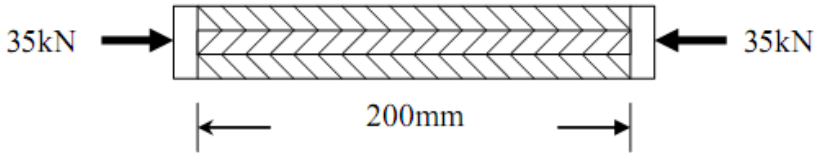

Fig.2 15

6 A beam of length 6 m is simply supported at its ends. It is loaded with a gradually varying load of 750 N/m from left hand support to 1500 N/m to the right hand support. Construct the S.F and B.M diagrams and find the amount and position of the maximum B.M over the beam. 15

7 A beam is simply supported and carries a uniformly distributed load of 40 kN/m run over the whole span. The section of the beam is rectangular having width and depth as 500 mm and 200 mm. If the maximums stress in the material of the beam is 120 N/mm^2, find the span of the beam. 15

8 A beam of cross section of an isosceles triangle is subjected to a shear force of 30 kN at a section where base width = 150 mm and height = 450 mm. 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. 15

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1 a) Define free body diagram, Transmissibility of a force and resultant of a force. [7]

b) Two identical rollers, each of weight 100 N, are supported by an inclined plane and a vertical wall as shown in Figure 1. Assuming smooth surfaces, find the reactions induced at the points of support A, B and C. [8]

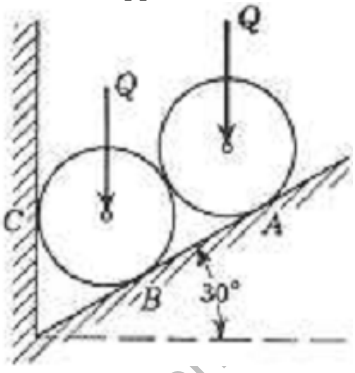

Fig. 1

2 a) Explain the principles of operation of a screw-jack with a neat sketch. 7

b) A block of weight 80 N is placed on a horizontal plane where the coefficient of friction is 0.25. Find the force that should be applied to the block at an angle of 30^0 with the horizontal to attain the condition of limiting equilibrium. 8

3 a) Show that the maximum power can be transmitted at $T_{max} = 3\ T_c$ 8

b) The centre of two pulleys of diameter 120mm and 420mm are 300mm apart. They are connected by an open belt. If the coefficient of friction for the larger pulley be 0.28, what would be its value for the smaller pulleys simultaneously? 7
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Code No: R21011 **R10** SET - 3

4 a) Determine the product of inertia of shaded area as shown in Figure.2 about the x-y axis. 8

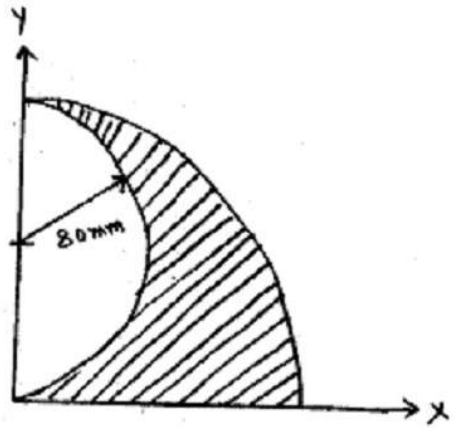

Fig.2

b) Define mass moment of inertia and explain Transfer formula for mass moment of inertia. 7

5 a) Derive the relationship between E and G. 5

b) A tensile load of 60kN is gradually applied to a circular bar of 4cm diameter and 5m long. If the value of E = 2 x 10^5 N/mm^2 , determine 10
(i). stress in the rod
(ii). strain energy absorbed by the rod
(iii) Find the above, if the same load is applied suddenly.

6 A simply supported beam of length 8 m rests on supports 6 m apart, the right hand end is overhanging by 2m. The beam carries a uniformly distributed load of 1500 N/m over the entire length. Draw S.F and B.M diagrams and find point of contraflexure, if any. 15

7 A timber beam of rectangular section is to be support a load of 20 kN uniformly distributed over a span of 3.6 m when beam is simply supported. If the depth of section is to be twice the breadth, and the stress in the timber is not exceed 7 N/mm^2, find the dimensions of the cross-section.How would you modify the cross section of the beam, if it carries a concentrated load of 20 kN placed at the centre with the same ratio of breadth to depth. 15

8 A simply supported wooden beam of span 1.3 m having a cross section 150 mm wide by 250 mm deep carries a point load W at the centre. The permissible stress are 7 N/mm^2 in bending and 1 N/mm^2 in shearing. Calculate the safe load W. 15

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1 a) A mast AB supported by a spherical socket at A and guy wires BC and BD carries a vertical load P at B as shown in the Figure.1. Point B is 0.3 m vertically below the xy plane. Find the axial force induced in each of the three members of this system. 15

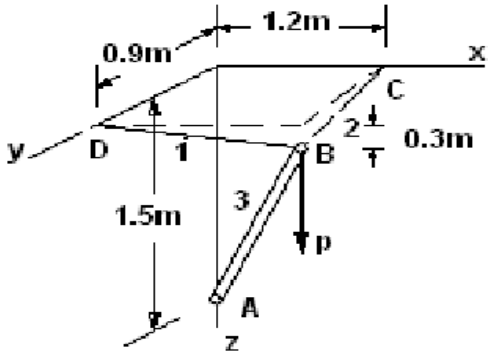

Figure.1

2 a) Define the following 8
i. Friction
ii. Angle of friction
iii. Limiting friction
iv. Cone of friction

b) A ladder 5m long and of 250N weight is placed against a vertical wall in a position where its inclination to the vertical is 30^0. A man weighing 800N climbs the ladder. At what position will he induce slipping? The co-efficient of friction for both the contact surfaces of the ladder with the wall and the floor is 0.2 7

3 Power transmitted between two shafts 3.5m apart by a crossed belt drive round two pulley, 600mm and 300 mm in diameters is 6KW. The speed of the larger pulley is 220 r.p.m. The permissible load on the belt is 25N/ mm width of the belt which is 5 mm thick. The coefficient of friction between the smaller pulley surface and the belt is 0.35. 15
Determine:
(a) Necessary length of the belt
(b) The width of the belt, and
(c) The necessary initial in the belt.
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4 a) Locate the centroid of a shaded area as shown in fig 2. 8

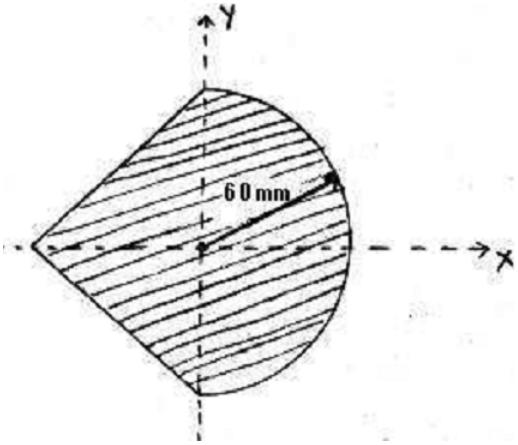

Fig. 2

b) A right circular cone has the radius of base as 200mm and height 500mm. The mass density of the cone is 7800 kg/m^3. Find out the mass moment of inertia of this cone about a line which passes through the vertex of the cone and which is parallel to the base of the cone. 7

5 a) A rod of diameter 10 mm length 1.5 m hangs vertically from the ceiling of a roof. A collar is attached at its lower end on which a load of 250 N falls from a height of 200 mm. find the strain energy absorbed and the instantaneous deflection of the rod. 7

b) A circular steel bar having three segments is subjected to various forces at different cross-sections as shown in Fig 3 Determine the necessary force to be applied at section C for the equilibrium of the bar. Also find the total elongation of the bar. E= 202 Gpa. 8

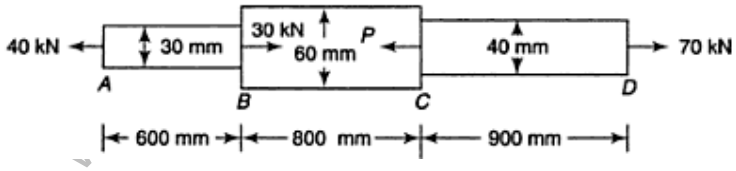

Fig. 3

6 Draw the shear and bending-moment diagrams for the beam and loading shown in fig. 4. 15

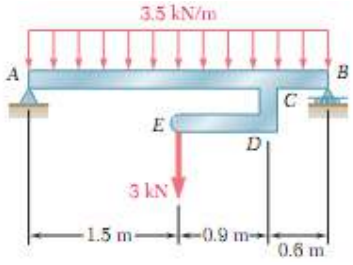

Fig. 4

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7 a) An I section shown in fig 5. is simply supported over a span of 12 m. If the maximum permissible bending stress is to 80 N/mm^2, What concentrated load can be carried at a distance of 4m from one support?

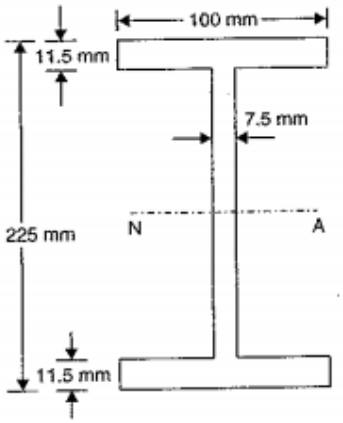

Fig.5

8 An I –section has the following dimensions: 15
Flanges:150mmX 20 mm
Web : 30 mm X 10 mm
The maximum shear stress developed in the beam is 16.8 N/mm^2. Find the shear force to which the beam is subjected.