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

II B. Tech I Semester Supplementary Examinations, September - 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) State and prove the theorem of varignon
   b) Two smooth spheres each of weight W and each of radius 'r' are in equilibrium in a horizontal channel of width 'b' (b<4r) and vertical sides as shown in Figure 1. Find the three reactions from the sides of channel which are all smooth. Also find the force exerted by each sphere on the other. Center of the bottom sphere and lowest point of the upper sphere are in the same horizontal plane.

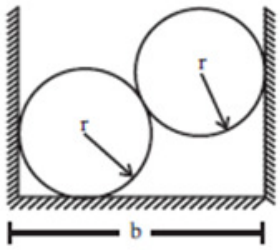

Figure 1

2. a) Explain types of Friction and Laws of Friction.
   b) A ladder of length 'L' rests against a wall, the angle of inclination being 45°. If the coefficient of friction between the ladder and the ground that between the ladder and the wall be 0.5 each, what will be the maximum distance on ladder to which a man whose weight is 1.5 times the weight of ladder may ascend before the ladder begins to slip?

3. a) What is a belt? How many types of belts are used for power transmission?
   b) Prove that the ratio of belt tension is given by the $T_1/T_2 = e^{\mu\theta}$

4. a) State and prove theorems of Pappus.
   b) Calculate the moment of inertia of a right circular cylinder of uniform density, radius of base ***a*** and altitude *h* with respect to its geometric axis (Refer Figure 2)

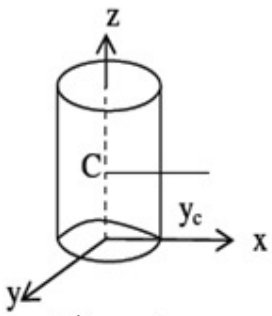

Figure 2
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5. a) Discuss stress-strain plot of a structural steel giving salient features.
   b) A steel rod 30 mm diameter and 300mm long is subjected to tensile force P acting axially. The temperature of the rod is then raised through 60^0C and total extension measured as 0.30mm. Calculate the value of tensile force P. Take E_S for of steel =200 GN/m^2 and α_S of steel =12 x $10^{-6}/^0$C

6. a) Define S.F. and B.M. and derive the relation between shear force and bending moment.
   b) Draw S.F.D and B.M.D for the overhanging beam shown in figure 3.

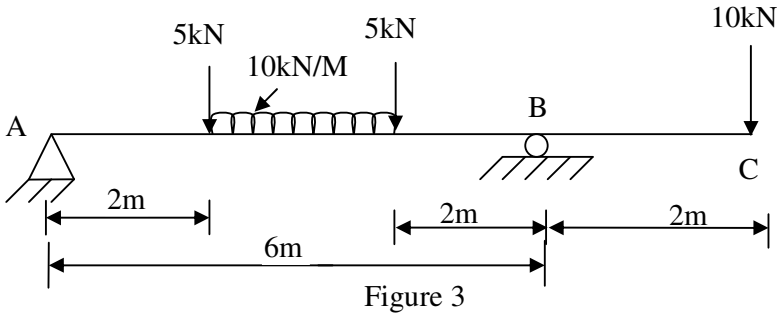

Figure 3

7. a) Write the assumptions in simple bending theory and derive simple bending equation.
   b) A beam of I section has overall dimensions of 350×150 mm. The thickness of flange and web are 10 mm. Calculate the maximum bending stress across a section and draw the stress distribution, if the beam carries a u.d.l of 12 kN/m for a span of 5m.

8. A beam of I section has overall dimensions of 400×200 mm. The thickness of flange and web are 12 mm. Calculate the maximum shear stress across a section and draw the stress distribution if it carries a shearing force of 300 kN at a section.

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

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1. a) Enumerate different laws of motion, discussing the significance of each them. What do you understand by transfer of force to parallel position? Also explain Varignon's theorem of moments in brief.
   b) What do you understand by resultant of a force system and which are the methods used for determining the resulting of coplanar concurrent force system? Four forces having magnitudes of 20N, 40N, 60N and 80N respectively, are acting along the four sides (1m each), of a square ABCD taken in order, as shown in figure 1. Determine the magnitude and direction of the resultant force.

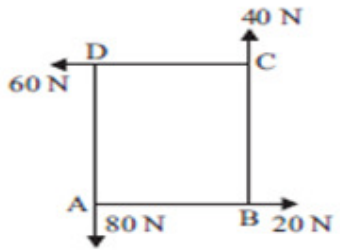

Figure 1

2. a) Explain the following:
   i) Laws of static friction. ii) Application of friction.
   b) Outside diameter of a square threaded spindle of a screw Jack is 50mm. The screw pitch is 15mm. 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 4000N
   ii) The efficiency of screw jack
   iii) Force required to be applied at pitch radius to lower the same load of 4000N

3. a) Explain how many types of belt drives are used for power transmission? Also derive their velocity ratio.
   b) With the help of a belt an engine running at 200 rpm drives a line shaft. The Diameter of the pulley on the engine is 80 cm and the diameter of the pulley on the line shaft is 40 cm. A 100 cm diameter pulley on the line shaft drives a 20 cm diameter pulley keyed to a dynamo shaft. Find the speed of the dynamo shaft when: (i) There is no slip (ii) There is a slip of 2.5% at each drive.
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4. a) Determine the distance of the center of gravity of a homogeneous truncated right circular cone from the plane of the base if the radius of the base is $\mathbf{r_1}$ the radius of the top $\mathbf{r_2}$ and the altitude of the truncated portion $\boldsymbol{h}$.
   b) Derive an expression to determine the moment of inertia of a semi circle about its diametric base.

5. a) A hollow cast-iron cylinder 4 m long, 300 mm outer diameter, and thickness of metal 50 mm is subjected to a central load on the top when standing straight. The stress produced is 75000 kN/m^2. Assume Young's modulus of cast iron as 1.5 x 10^8 KN/m^2 , find
   i) Magnitude of the load,
   ii) Longitudinal strain produced and
   iii) Total decrease in length
   b) Define Resilience and derive the equation of stresses for a body subjected to sudden and Impact loading

6. a) Draw S.F.D and B.M.D for the simply supported beam shown in Figure 2.

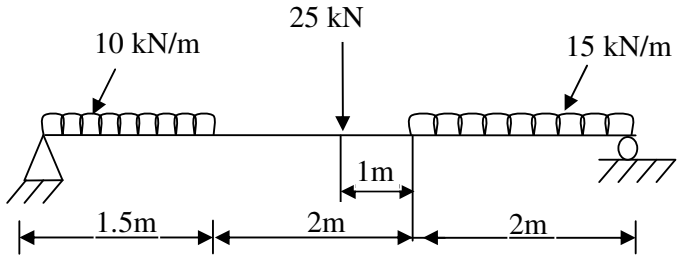

Figure 2

   b) Draw S.F.D and B.M.D for the cantilever beam shown in Figure 3.

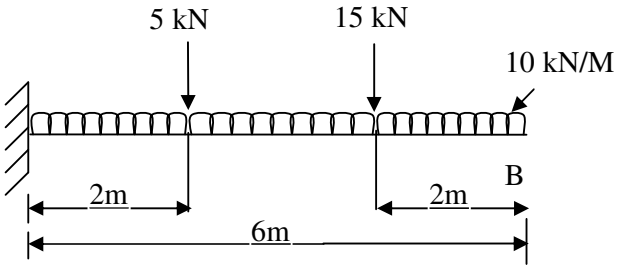

Figure 3

7. a)Write the assumptions in simple bending theory and derive simple bending Equation
   b) Define section modulus and derive section modulus for a rectangular and circular section.

8. Derive the shear stress equation and draw the shear stress distribution for a symmetrical I-section.

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

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1. a) State the transmissibility of force and also State the necessary and sufficient conditions of equilibrium of a system of coplanar non concurrent force system
   b) Forces 2, 3, 5, 3 and 2 kN respectively act at one of the angular points of a regular-hexagon towards five other angular points. Determine the magnitude and direction of the resultant force.

2. a) Explain law of coulomb friction? What are the factors affecting the coefficient of friction and effort to minimize it.
   b) The 4.2 m long ladder AB weights 200 N. It rests against a vertical wall and on horizontal floor as shown in Figure 1. What must be the coefficient of friction μ for equilibrium?

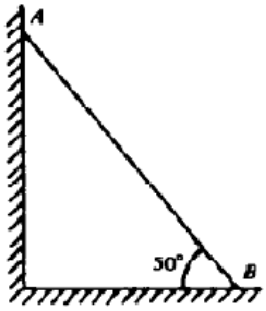

Figure 1

3. a) Explain how you evaluate power transmitted by the belt.
   b) Find the length of belt necessary to drive a pulley of 500 mm diameter running parallel at a distance of 12 m from the driving pulley of diameter 1600 mm.

4. a) Determine the coordinate y_c of the center of gravity C of a right circular cylindrical can of height h and radius of base r if it is made of very thin metal of uniform thickness and density. The can is closed at the bottom and open at the top.
   b) Derive an expression to determine moment of inertia of a semi circle about its diametric base
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5. a) Explain the principle of superposition and explain the procedure for evaluating elongation of a bar of varying cross section?

   b) A beam weighing 50 N is held in horizontal position by three wires. The outer wires are of brass of 1.8 mm diameter and attached to each end of the beam. The central wire is of steel of 0.9 mm diameter and attached to the middle of the beam. The beam is rigid and the wires are of the same length and unstressed before the beam is attached. Determine the stress induced in each of the wire. Take Young's modulus for brass as 80 *GN*/m^2 and for steel as 200 *GN*/m^2. (Figure 2)

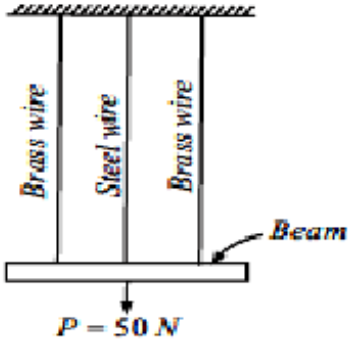

Figure 2

6. a) Define a beam. What is a cantilever, a simply supported and a overhang beam? What is the point of contra flexure ?

   b) Draw S.F.D and B.M.D for the cantilever beam shown in Figure 6.

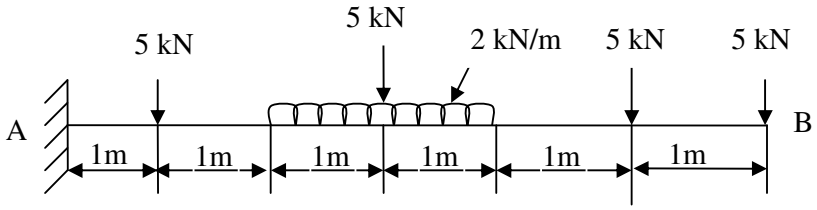

Figure 6

7. a) Compare the strength of solid circular, Rectangular and I section of equal weight.

   b) What is the relation between maximum tensile stress and maximum compressive stress in any section of a beam?

8. A beam of I section has overall dimensions of 400×200 mm. The thickness of flange and web are 12 mm. Calculate the maximum shear stress across a section and draw the stress distribution if it carries a shearing force of 275kN at a section.

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

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1. a) Explain the following:
   i) Principle of transmissibility of a force.
   ii) Necessary and sufficient conditions of equilibrium of a system of coplanar force system.
   b) The weight and radii of the three cylinders piled in a rectangular ditch as shown in figure1. W_A=80N, W_B=160N, W_C=80N. Assuming all contact surfaces to be smooth. Determine the reactions acting on cylinder C.

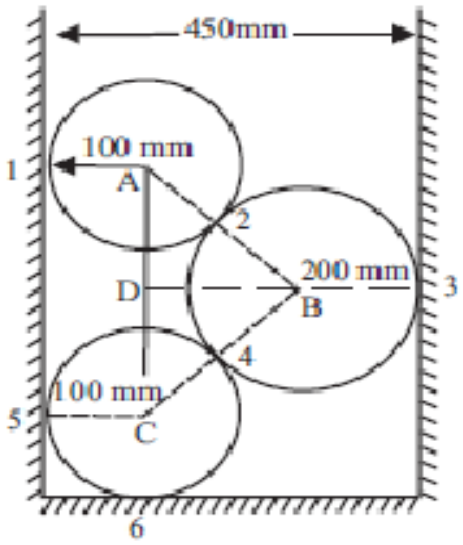

Figure 1

2. a) Define the following terms;
   i) Angle of friction
   ii) Angle of Repose
   iii) Cone of Friction.
   b) A body on contact with a surface is being pulled along it with force increasing from zero. How does the state of motion of a body change with force? Draw a graph and explain.

3. a) What is initial tension in the belt?
   b) Find speed of shaft driven with the belt by an engine running at 600RPM. The thickness of belt is 2cm, diameter of engine pulley is 100cm and that of shaft is 62cm.

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4. a) Derive an expression to determine moment of inertia of a semi circle about its diametric base
   b) Find out the M.I. of T section as shown in fig 2 about *X-X* and *Y-Y* axis through the *C.G.* of the section.

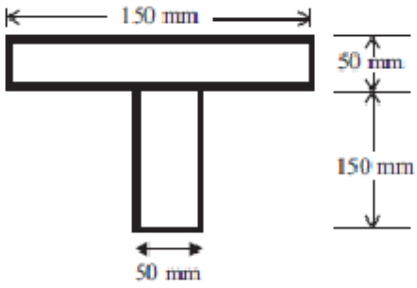

Figure 2

5. a) Discuss stress strain plot of a structural steel giving salient features.
   b) A steel rod 2.5 m long is secured between two walls. If the load on the rod is zero at 20°C, compute the stress when the temperature drops to -20°C. The cross-sectional area of the rod is 1200 mm^2, α = 11.7 μm/ (m°C), and E = 200GPa, assuming
   i) That the walls are rigid and
   ii) That the walls spring together a total distance of 0.5 mm as the temperature drops.

6. a) Define a beam. What is a cantilever, a simply supported and an overhang beam? What is the point of contra flexure ?
   b) Draw the shear force and bending moment diagram for the beam as shown in Figure 3.

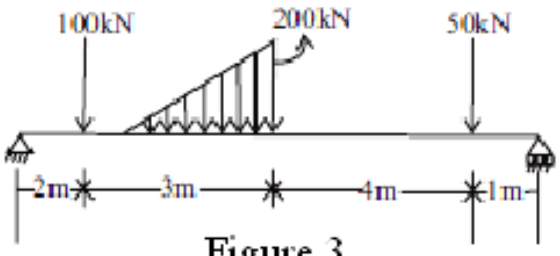

Figure 3

7. a) Write the assumptions in simple bending theory and derive simple bending equation.
   b) Compare the strength of solid circular, Rectangular and I section of equal weight.

8. Derive the equation for calculating the shear stress intensity across a section and derive and draw shear stress distribution across a T section.