

**GUJARAT TECHNOLOGICAL UNIVERSITY**  
**BE - SEMESTER- 1<sup>st</sup> / 2<sup>nd</sup> • EXAMINATION – SUMMER 2013**

**Subject Code: 110010****Date: 19-06-2013****Subject Name: Mechanics of Solids****Time: 02:30 pm – 05:00 pm****Total Marks: 70****Instructions:**

1. Attempt any five questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.

- Q.1** (a) Define: (i) Space (ii) Particle (iii) Equilibrant **03**  
 (b) Locate the centroid of composite line ABCD as shown in **figure 1**. **04**  
 (c) A cord supported at A and B carries a load of 20kN at D and a load of W at C as shown in **figure 2**. Find the value of W so that CD remains horizontal. **07**
- Q.2** (a) State: (i) Law of Parallelogram of Forces (ii) Law of Triangle of Forces **03**  
 (b) A wooden beam 2m long, simply supported at ends, has rectangular section 150mm × 600mm and carries a point load of 20kN at center of the beam. Calculate the bending stress at a layer 200mm above the bottom of the beam, the layer being of the section distant 0.8m from left support. **04**  
 (c) Find forces in members CD, FG and FD. The truss is shown in **figure 3**. **07**
- Q.3** (a) Enlist various type of loads and type of supports. **03**  
 (b) A beam of rectangular section 100mm × 300mm is subjected to a shear force of 10kN. Find shear stress at the top layer, at neutral layer and the average value of shear stress. Show the stress distribution diagram. **04**  
 (c) Some forces are acting on a rigid body as shown in **figure 4**. Find the resultant of the given force system, in terms of magnitude and direction. Find the location of the Resultant with respect to point O. **07**
- Q.4** (a) Distinguish between perfect, unstable and redundant trusses. Illustrate with sketches. **03**  
 (b) Find reaction at support A and B for the beam shown in **figure 5**. **04**  
 (c) Calculate shear force and bending moment at salient points of the beam shown in **figure 6**. Draw shear force diagram and bending moment diagram for the beam. **07**
- Q.5** (a) State Pappus-Guldinus first theorem and prove it. **03**  
 (b) A force is acting at an angle of 45°. Find the components along the axes m-m and n-n as shown in **figure 7**. **04**  
 (c) Find the moment of inertia of the area about x-x axis as shown in **figure 8**. **07**
- Q.6** (a) Define: (i) Coefficient of friction (ii) Angle of friction (iii) Stress **03**  
 (b) Refer **figure 9**. The coefficient of frictions between the block and the inclined plane is 0.2. Determine the least value of the force P required just to move the block up along the inclined plane. **04**  
 (c) A steel rod of 30mm diameter is placed inside a copper tube of external diameter 50mm and internal diameter 40mm, having length equal to 500mm and connected rigidly at the ends as shown in **figure 10**. The bar is subjected to axial pull of 150kN. Find the stresses in each material and elongation of the composite bar. Take  $E_{\text{steel}} = 200 \text{ GPa}$  and  $E_{\text{copper}} = 100 \text{ GPa}$ . **07**
- Q.7** (a) A uniform ladder of weight 250N and length 5m is placed against a vertical wall in a position where its inclination to the vertical is 30°. A person weighing 700N climbs the ladder. At what position of the person the ladder **07**

will start to slip? Take coefficient of friction  $\mu = 0.2$  at both the contact surfaces of the ladder.

- (b) For the state of stress as shown in **figure 11** determine location of principal planes, principal stresses and maximum shear stress.

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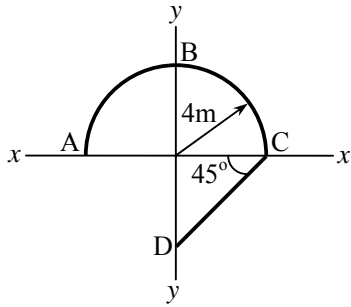


Fig. 1 [Q-1(b)]

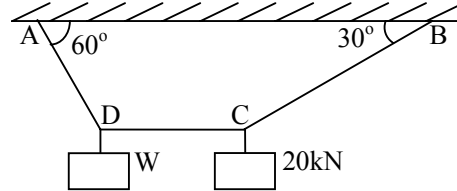


Fig. 2 [Q-1(c)]

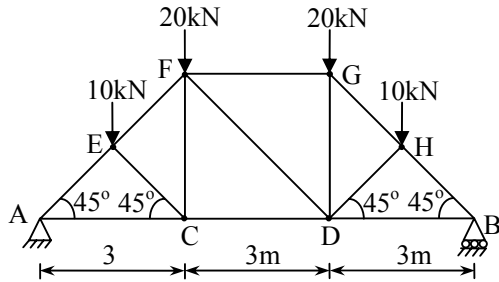


Fig. 3 [Q-2(c)]

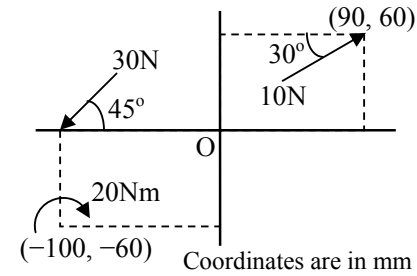


Fig. 4 [Q-3(c)]

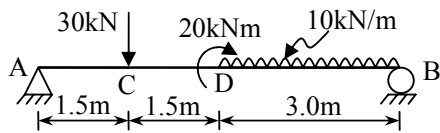


Fig. 5 [Q-4(b)]

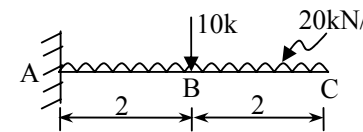


Fig. 6 [Q-4(c)]

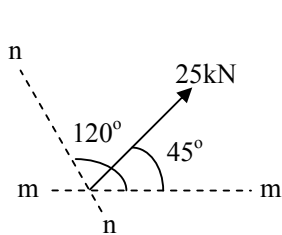


Fig. 7 [Q-5(b)]

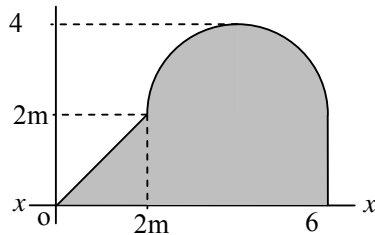


Fig. 8 [Q-5(c)]

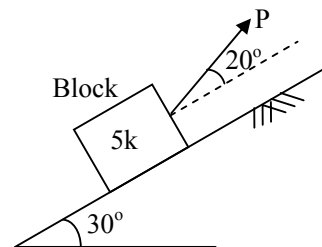


Fig. 9 [Q-6(b)]

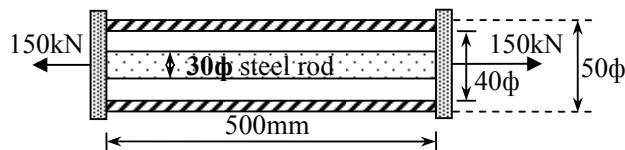


Fig. 10 [Q-6(c)]

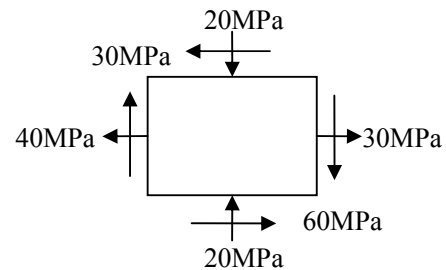


Fig. 11 [Q-7(b)]