Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER– 1st / 2nd • EXAMINATION – WINTER 2013

Subject Code: 110010 **Date: 31-12-2013**

Subject Name: Mechanics of Solids

Time: 10:30 am – 01:00 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) Fill in the blanks with most appropriate word/words. **08**

1. Beam extends beyond the support then that beam is known as_____ beam.
2. Moment of inertia of any plane area is maximum about an axis passing though_____.
3. Every joint of plane truss is having _____force system and system of forces is in equilibrium.
4. Deficient truss has members (N)_____ (2j-3)
5. At free end of a cantilever bending moment is always_____ unless a concentrated moment is applied at the free end.
6. _____ of a force is the procedure of splitting a force into number of components.
7. _____ is equal and opposite to the resultant of several forces, acting on a body.
8. Force of friction is _____ to the applied force, which tends to move the body.

(b) A steel member ABCD with three different circular cross-section and lengths as follows, is subjected to an axial pull of 150kN. Compute the net change in the length of the member if the modulus of elasticity (E)=200GPa. **06**

- AB: diameter=40mm and length=750mm
- BC: diameter=25mm and length=1000mm
- CD: diameter=30mm and length=1200mm

Q.2 (a) The following forces are acting at a point, find the magnitude and direction of the resultant force. **05**

1. 550N acting towards North
2. 900N acting at 40° towards South of West
3. 1.25 kN acting at 60° towards South of East
4. 400N acting from West to East

(b) A cement concrete block having a shape of square cross section of 250mm side and a uniform height of 350mm is tested in a compression testing machine by applying an axial compressive load of 'P'. It was observed that the height decreased by 0.28mm and the side increased by 0.035mm. If the Modulus of Elasticity of concrete is 0.13×10^5 N/mm^2, determine **06**

- Poison's Ratio
- The value of 'P'

- The volumetric strain of the block.

(c) A steel rail is 10m long and is laid at a temperature of 20°C. The maximum temperature expected is 50°C, estimate the minimum gap between two rails to be left so that temperature stresses do not developed. The coefficient of linear expansion $\alpha_{steel}=12x10^{-6}$ per °C per unit length. **03**

Q.3 (a) Determine support reactions for the beam loaded as shown in fig.1. **07**

(b) Find the angle of tilt 'Θ' with horizontal so that the contact force (Reaction) at 'B' will be one-half at 'A' for a smooth cylinder of weight 100N. Refer fig.2. **07**

Q.4 (a) Determine the resultant and locate the same with respect to point 'A' of a non-concurrent force system shown in fig.3. **07**

(b) Find out forces in all the members of a truss shown in fig.4. **07**

Q.5 (a) Determine the centroid of the shaded area shown in fig.5. Also calculate the volume of the article generated by revolving the area about vertical axis 'AB'. **10**

(b) Calculate the Moment of inertia of the shaded area shown in fig.5 about the vertical axis 'AB'. **04**

Q. 6 (a) Draw Shear force and bending moment diagrams showing all necessary calculations for the beam loaded as show in fig.6. **08**

(b) A uniform ladder, of length 5m, is supported by a horizontal floor at 'A' and a vertical wall at 'B' and makes an angle of 60° with the horizontal. Find the maximum distance 'x' up the ladder at which a man of weight 700N can stand without causing slipping of the ladder. The coefficient of friction between floor & ladder and wall & ladder is 0.3. Neglect the weight of ladder. **06**

Q.7 (a) Determine maximum bending stress and maximum shear stress in a cantilever beam of length 2m. The beam carries a udl of 8kN/m over the entire length of 2m and a concentrated vertical downward load of 25kN at the free end of cantilever. The cross-section of the beam is a rectangle of size 350mm deep and 250mm wide. **08**

(b) The state of stress in two-dimensionally stressed body at a point is as shown in fig.7. Determine the principal stresses and maximum shear stress. **06**

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SKETCHES

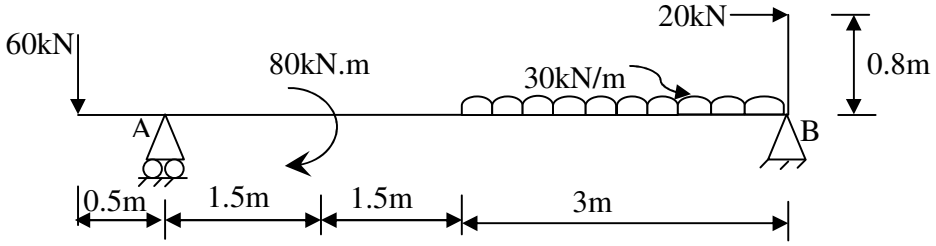

Fig.1 (Q:3(a))

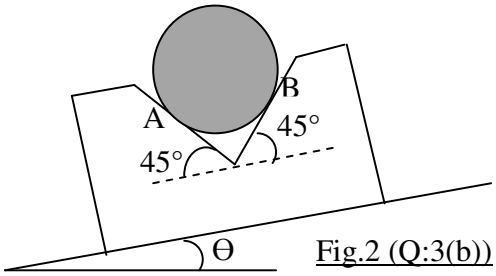

Fig.2 (Q:3(b))

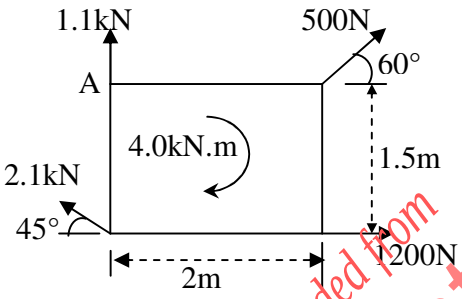

Fig.3(Q:4(a))

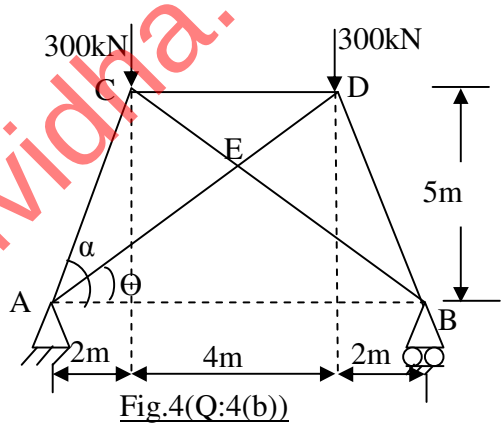

Fig.4(Q:4(b))

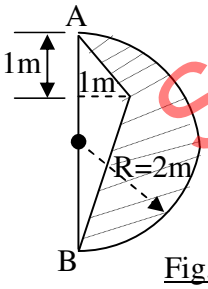

Fig.5(Q:5(a)&(b))

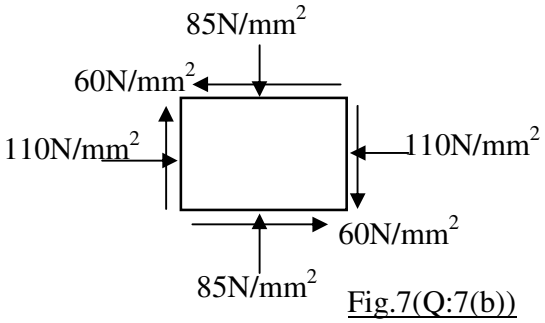

Fig.7(Q:7(b))

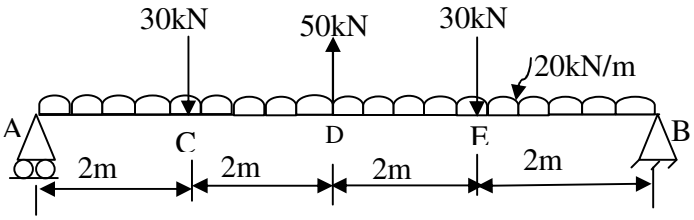

Fig.6(Q:6(a))