Seat No.: _____ *Enrolment No.*______

GUJARAT TECHNOLOGICAL UNIVERSITY

B.E. Sem-I Examination January 2010

Subject code: 110010 **Subject Name: Mechanics of solids**

Date: 12 / 01 / 2010 **Time: 11.00 am – 1.30 pm**

Total Marks: 70

Instructions:

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

Q.1 (a) Select appropriate answer from given options and rewrite the complete sentence. **07**

(i) Moment is a ________ vector, whereas Couple is a ________ vector. (free, null, fixed)

(ii) A truss is called perfect if m + r ____ 2j. (<, = , >)

(iii) The ratio of direct stress to volumetric strain is called ____________ (Modulus of Elasticity, Modulus of rigidity, Bulk Modulus)

(iv) At the point of cotraflexure ___________ changes its sign. (shear force, bending moment, axial force)

(v) Impact test measures _________ of material. (Toughness, Hardness, Brittleness)

(vi) Maximum possible value of Poisson's ratio is _____ . (0.5, 0.75, 1.0)

(vii) Shear stress on principal plane is _____ (maximum, zero, minimum)

(b) A single purchase crab winch has number of teeth on pinion and spur wheel as 25 and 100 respectively. The diameter of effort wheel and load drum is 25 cm and 6.25 cm respectively. The load of 240N can be raised by 20 N. Determine (i) Velocity ratio (ii) Mechanical Advantage (iii) Efficiency (iv) Ideal effort (v) Frictional effort (vi) Ideal load (vii) Frictional load. **07**

Q.2 (a) State laws of Dry friction. **02**

(b) Derive formula from first fundamental to determine extension ΔL of uniformly tapering circular bar of diameter d_1 at one end, d_2 at other end, length L, Modulus of Elasticity E and subjected to axial tensile force P. **05**

(c) **Fig. 1** shows a plane truss, check determinacy and calculate magnitude and nature of each member force and reactions for given loading on the truss. Tabulate all member forces showing their magnitude and nature. **07**

OR

(c) A uniform ladder AB weighing 230 N and 4m long, is supported by vertical wall at top end B and by horizontal floor at bottom end A as shown in **Fig. 2.** A man weighing 550 N stood at the top of the ladder. Determine minimum angle θ of ladder AB with floor for the stability of ladder. Take co efficient of friction between ladder and wall as 1/3 and between ladder and floor as 1/4. **07**

Q.3 (a) A system of four forces shown in **Fig. 3**, has resultant 50 kN along + X – axis. Determine magnitude and inclination of unknown force P. **04**

(b) Determine co ordinates of centroid with respect to 'O' of the section shown in **Fig. 4.** **04**

(c) Determine moment of inertia of a section shown in **Fig. 5** about horizontal centroidal axis. **06**

OR

Q.3	**(a)**	A section of a beam shown in **Fig. 6**, has moment of inertia about neutral axis is 11.6 x 10^6 mm^4. The section is subjected to shear force of 14.5 kN. Determine value of maximum shear stress on the section.	**04**
	(b)	Draw neat qualitative shear stress distribution sketches of following sections, indicating position of maximum shear stress. (i) H – section (ii) Solid circular section (iii) L – section (iv) I - Section	**04**
	(c)	A concrete member 90 mm wide X 120 mm deep and 3m long, has central axial longitudinal hole of diameter 30 mm throughout the length of member. A steel cable of 10mm diameter is passed through the hole end to end and fitted by nuts supported on rigid plates provided at the ends of beam, such that initially cable is stress free. Now the cable is tightened by turning the nuts, to reduce the length of the cable by 6 mm. Determine stresses in steel and concrete due to reduction in length of cable. Take Es = 210 GPa and Ec = 14 GPa.	**06**
Q.4	**(a)**	Determine moment of resistance of a section of a beam shown in **Fig.7**, if allowable bending stress is 230 MPa.	**07**
	(b)	Calculate shear force and bending moment at points A, B, C, D and E. for the beam shown in **Fig. 8**. Also plot neat shear force and bending moment diagrams indicating values at above points. Locate point of contraflexure from support B.	**07**

OR

Q.4	**(a)**	Derive condition of reversibility of a simple lifting machine with usual notations.	**04**
	(b)	A thin cylindrical shell of internal diameter 'd', length 'ℓ' and thickness 't' is subjected to internal pressure 'p'. Derive formula for hoop stress and longitudinal stress.	**04**
	(c)	Determine magnitude, direction and perpendicular distance from 'O', of the resultant for the force system shown in **Fig. 9**.	**06**
Q.5	**(a)**	A wire is tied straight between two rigid poles 10 m apart has initial tensile stress 10 N/mm^2 at 32° C. Calculate stress in wire if temperature reduces to minus 8° C. Take E = 75 x 10^5 N/mm^2 and α = 20 x 10^{-6} / °C.	**03**
	(b)	A square steel plate 50 mm x 50 mm and 20 mm thick is subjected to axial tensile force in horizontal and vertical direction 80 kN and 120 kN respectively as shown in **Fig10**. Calculate normal and tangential stresses on plane inclined at 30° to the plane carrying 80 kN force. Also calculate resultant stress and angle of obliquity.	**05**
	(c)	A rectangular block of size 300mm x 150mm x 100mm is subjected to forces as shown in **Fig. 11**. If E = 75 GPa and poisson's ratio is 0.25, calculate (i) Change in volume (ii) Modulus of rigidity and (iii) Bulk modulus.	**06**

OR

Q.5	**(a)**	Discuss briefly limitations of compression test on materials.	**03**
	(b)	A beam is loaded as shown in **Fig. 12**. Determine support reactions at supports A and B. Also identify type of beam.	**05**
	(c)	Calculate shear force, bending moment and axial thrust at points A, B, C and D for the beam shown **Fig. 13**. Also plot neat shear force, bending moment and axial thrust diagrams indicating values at above points.	**06**

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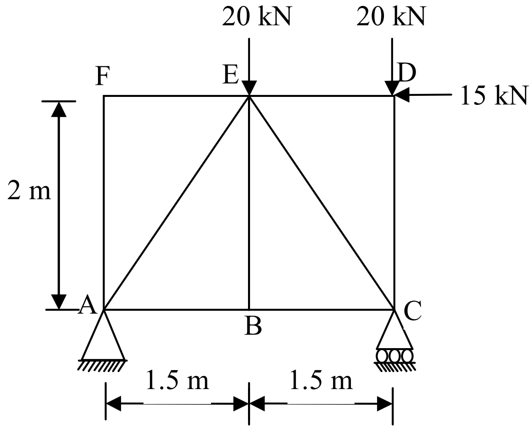

Fig. 1 Que 2(c)

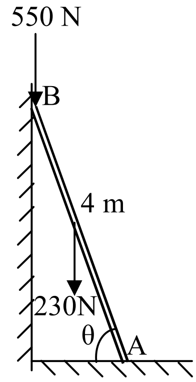

Fig. 2 Que 2(c) OR

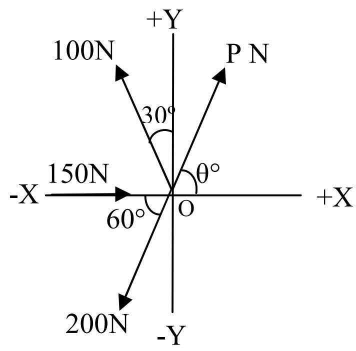

Fig. 3 Que 3(a)

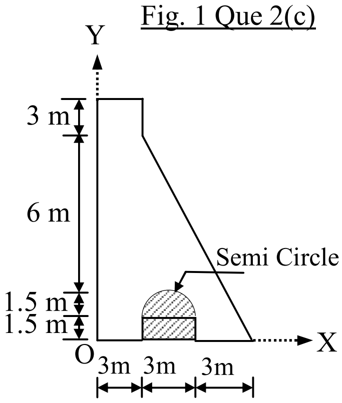

Fig. 4 Que 3(b)

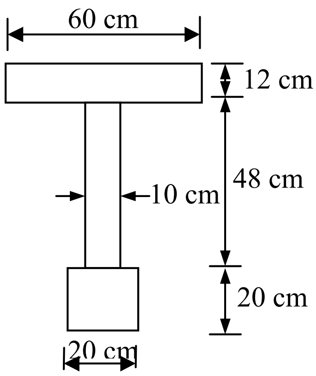

Fig. 5 Que 3(c)

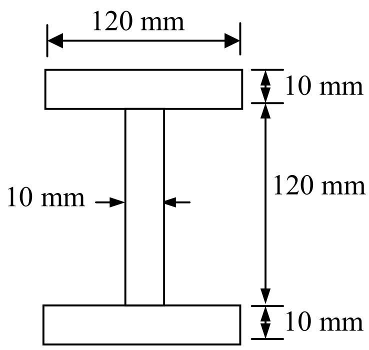

Fig. 6 Que 3(a) OR

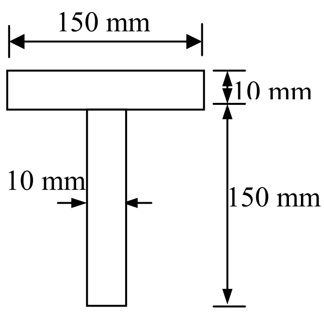

Fig. 7 Que 4(a)

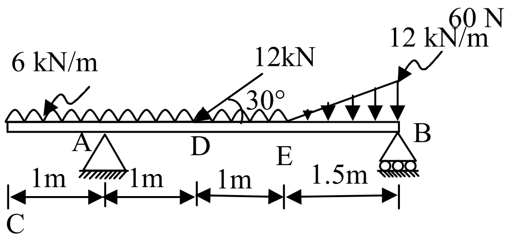

Fig. 8 Que 4(b)

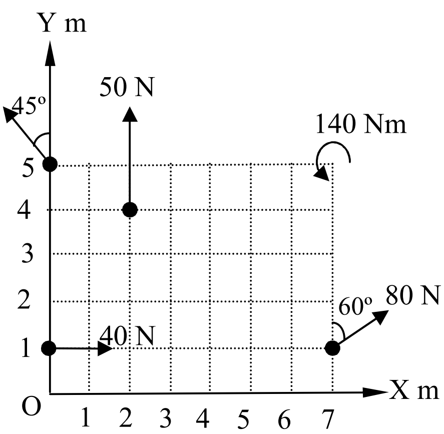

Fig. 9 Que 4(c) OR

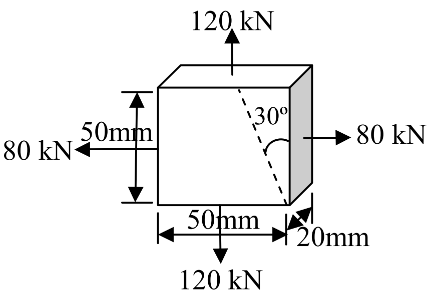

Fig. 10 Que 5(b)

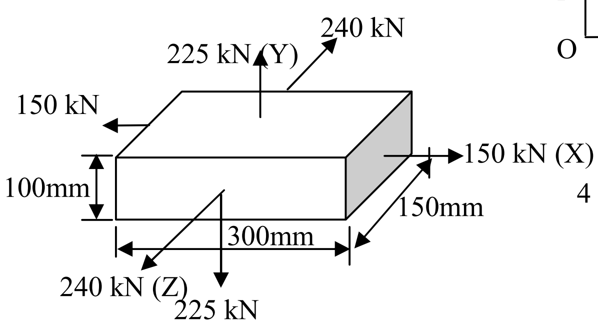

Fig. 11 Que 5(c)

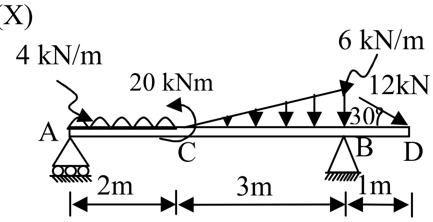

Fig. 12 Que 5(b) OR

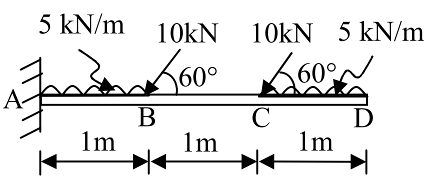

Fig. 13 Que 5(c) OR

All above figures are not to scale.