Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

B.E. Sem-II Remedial Examination September 2009

Subject code: 110010

Subject Name: Mechanics of Solids

Date: 08/09/2009 **Time: 11:00am-1:30pm**

Total Marks: 70

Instructions:

1. **Write seat no. and enrolment no. at given location on question paper.**
2. **Attempt all questions.**
3. **Make suitable assumptions wherever necessary.**
4. **Figures to the right indicate full marks.**

Q.1 (a) Define force. Discuss its characteristics. **03**

(b) Determine magnitude and direction of resultant force of the force system shown in **fig. 1**. **04**

(c) A stepped bar ABCD is axially loaded as shown in **fig. 2**, is in equilibrium. Determine (i) magnitude of unknown force 'P' (ii) stresses in each part and (iii) total change in length of the bar. Details of each part of the bar is as follow: **07**

Sectional/Material properties	Part AB	Part BC	Part CD
C/S Area in mm^2	500	600	500
Modulus of Elasticity in Gpa	210	100	80

Q.2 (a) Write assumptions made in the analysis of plane truss. **02**

(b) The results of experiments of a simple lifting machine are as follow. **05**

W (N)	10.0	15.0	20.0	25.0	30.0
P (N)	3.750	4.375	5.000	5.625	6.250

The velocity ratio of the machine is 10. Determine (i) law of machine (ii) maximum efficiency (iii) ideal effort and efficiency at 60 N load.

(c) A simply supported overhang beam ABCD is loaded as shown in **fig. 3** Calculate shear force and bending moments at salient points and plot shear force and bending moment diagrams. Also locate point of contraflexure from support A. **07**

OR

(c) A mechanism shown in **fig. 4** is hinged at A, is acted by horizontal force of 500N at C. Determine least force 'P' required at E for equilibrium of the mechanism and corresponding angle 'θ'. **07**

Q.3 (a) A steel tube of 2 m length is subjected to 50° C rise in temperature. Determine (i) free natural expansion and (ii) stress developed in the tube, if expansion is prevented. Take Es = 2.0×10^5 N/mm^2 and Co efficient of thermal expansion $\alpha = 12 \times 10^{-6}$ per ° C. **02**

(b) Determine moment of inertia of a section shown in **fig. 5** about horizontal centroidal axis. **05**

(c) Calculate member forces in a plane truss loaded as shown in **fig. 6**, using either method of joint or method of section. Tabulate member forces showing magnitude and nature. **07**

OR

Q.3	(a)	Draw neat typical sketches for the simple lifting machine showing relation between : (i) Total effort / frictional effort / ideal effort (all three on same co ordinate axes) versus load. (ii) Efficiency versus load.	**02**
	(b)	A cantilever beam is loaded as shown in **fig. 7** Calculate shear force and bending moments at salient points and plot shear force and bending moment diagrams.	**05**
	(c)	Determine volume of revolution generated by revolving plane lamina ABCDEA shown in **fig. 8,** about y –y axis, to 2π rad. Write statement of theorem used for calculating volume.	**07**
Q.4	(a)	Explain following terms: (i) hardness (ii) proof stress (iii) factor of safety.	**03**
	(b)	State and prove parallel axis theorem with usual notations.	**05**
	(c)	A 15º wedge 'A' is pushed to move block 'B' weighing1000 N as shown in **fig. 9** Determine the least force 'P' required, if the angle of friction for all contact surfaces is 14º . Neglect self weight of the wedge.	**06**

OR

Q. 4	(a)	Enlist various beam supports with neat symbolic sketches, showing all possible reactions for general loading condition.	**03**
	(b)	A short concrete column 300mm x 300mm in section is carrying axial load of 360 kN. The column is strengthened by four, 12mm diameter steel bars each one at corner. Calculate stresses in concrete and steel. Take Ec = 14 GPa and Es = 210 Gpa.	**05**
	(c)	At a point in a strained material the state of stress is as shown in **fig. 10.** Determine (i) location of principal planes (ii) principal stresses and (iii) maximum shear stress and location of plane on which it acts.	**06**
Q.5	(a)	Derive relation between bulk modulus (K), poission's ratio (1/m), and modulus of elasticity (E).	**04**
	(b)	Derive the relation f /y = E /R with usual notations.	**04**
	(c)	At a section of beam shown in **fig. 11,** shear force is 150 kN. Determine shear stress at points A, B, C and D and draw shear stress distribution across the section showing above stresses.	**06**

OR

Q.5	(a)	Prove that maximum shear stress in a rectangular section is 1.5 times average shear stress with usual notations. Also sketch shear stress distribution across the section.	**04**
	(b)	A cylindrical roller 600mm diameter and weighing 1000 N is resting on a smooth inclined surface, tied firmly by a rope AC of length 600mm as shown in **fig. 12** Find tension in rope and reaction at B.	**04**
	(c)	A 300mm wide x 400mm deep timber joist is strengthen by joining 300mm wide x 10mm thick steel plate at its bottom surface as shown in **fig. 13.** The composite beam is simply supported at its ends and carries a uniformly distributed load of 30 kN/m over an effective span of 6m. Find the maximum bending stress in the steel and timber at mid span section. Take E(steel) = 210 GPa and E(timber) = 14 GPa.	**06**

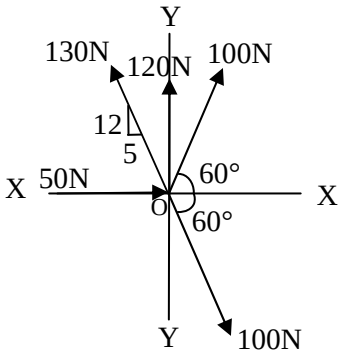

Fig-1 Que 1(b)

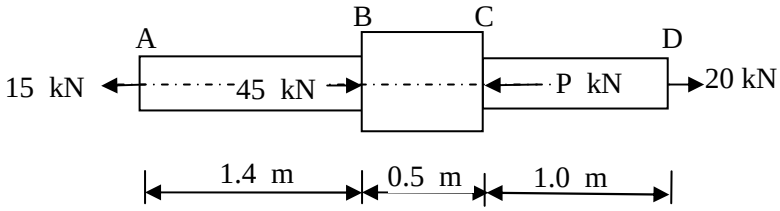

Fig. 2 Que. 1 (c)

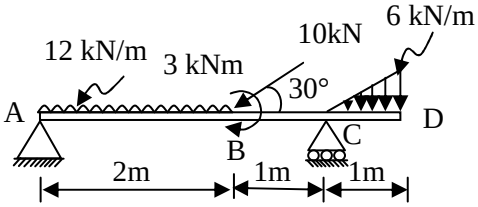

Fig. 3 Que. 2(c)

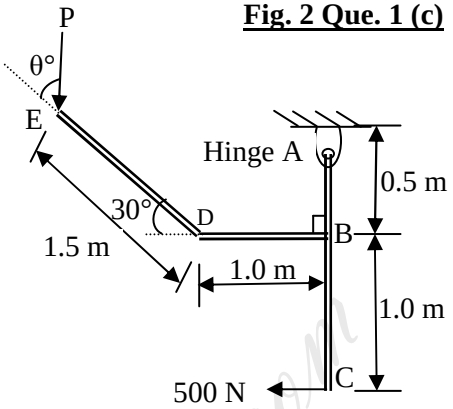

Fig -4 Que 2(c) OR

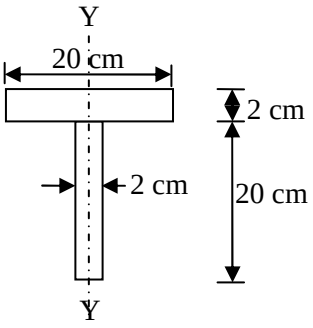

Fig. 5 Que 3 (b)

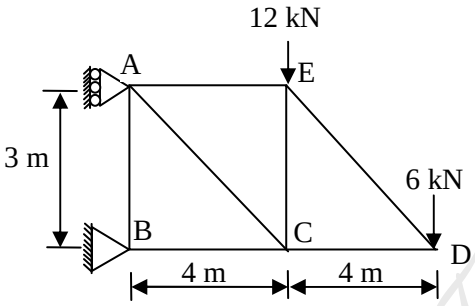

Fig. 6 Que 3 (c)

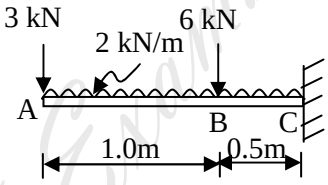

Fig. 7 Que 3(b) OR

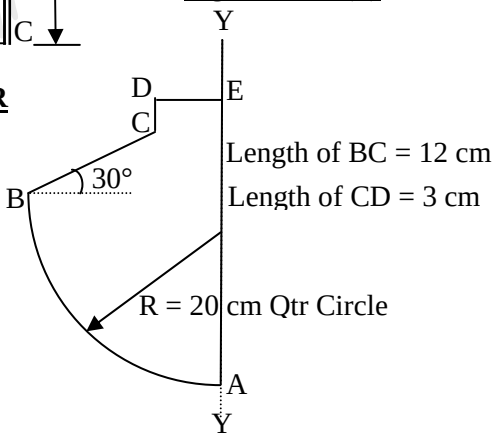

Fig. 8 Que 3(c) OR

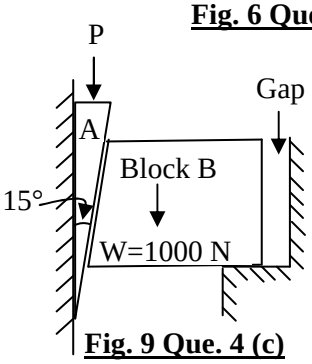

Fig. 9 Que. 4 (c)

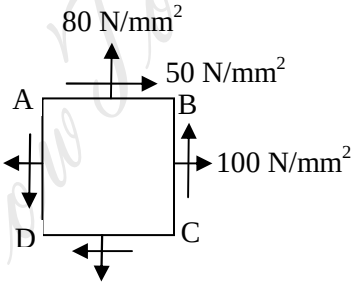

Fig. 10 Que 4 (c) OR

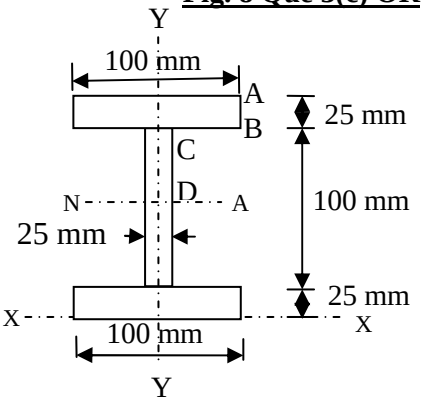

Fig.11 Que 5 (c)

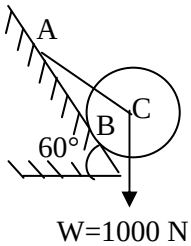

Fig. 12 Que. 5 (b) OR

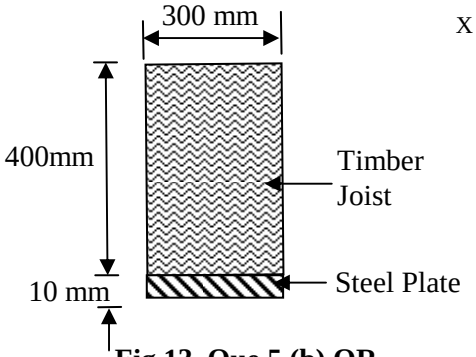

Fig 13. Que 5 (b) OR

ALL FIGURES ARE NOT TO SCALE