Seat No.: _____ *Enrolment No._____*

GUJARAT TECHNOLOGICAL UNIVERSITY

B.E. Sem-I Remedial Examination March / April 2010

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

Date: 09 /04 / 2010 **Time: 12.00 Noon – 02.30 pm**

Total Marks: 70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **All dimensions in sketches are in mm, unless specified.**

Q.1 **(a)** Fill in the blanks with the most appropriate answer (Write complete sentence with its answer). Attempt **Any Eight**. **08**

i) Three coplanar non-parallel forces in equilibrium will _____ [always, never, sometimes] be concurrent.

ii) 10^6 kg = _____ [10^3, 10^{-6}, 10^9, 10^{-3}] Mg.

iii) On oiling the lifting machine _____ [velocity ratio, mechanical advantage, efficiency, law of machine] is NOT affected.

iv) Coefficient of static fiction is _____ [less than, more than, equal to] coefficient of dynamics fiction.

v) A mild steel bar under tension test shows property of _____ [malleability, ductility, tensionability].

vi) The shape of shear force diagram for cantilever beam subjected to couple at free end is _____ [horizontal straight line, zero, parabola, incline straight line].

vii) The ratio of the maximum shear stress to average shear stress is for 4/3, the cross section would be _____ [triangular, rectangular, circular, hexagonal].

viii) Which one of expressions is NOT true _____ [$E = 2G(1+\mu)$, $E = 3K(1-2\mu)$, $E = 9KG/(3G+K)$, $M = \sigma.I/y$].

ix) Point of contra flexure is where _____ [shear force is zero, shear force changes sign, bending moment changing sign, bending moment is zero].

(b) Attempt **Any Two** from the following. **06**

i) State and explain Varignon's theorem.

ii) Using first principle, obtain moment of inertia of triangular lamina about centroidal axis parallel to base.

iii) Derive a relation between shear stress produced in the beam of width B, having moment of inertia I and subjected to shear force S.

iv) Derive differential equations relating uniformly distributed load, shear force and bending moment.

Q.2 **(a)** For the system of forces on a lamina OABC is shown in **fig. 1,** find magnitude and direction of the resultant force. Also locate the resultant either showing perpendicular distance from point O OR the point of the inter section on X axis/Y axis. **07**

(b) For an overhanging beam shown in **fig. 2,** compute the magnitudes and directions of reactions at A & B using,

i) condition of equilibrium **03**

ii) Lami's theorem **04**

OR

(b) For a plane truss shown in **fig. 3,**

i) determine reactions at supports A & B **03**

i) identify members carrying zero force **02**

ii) compute internal forces in the top chord either BC or CD or DE and in the bottom chord either EF or FG or GA. **02**

Q.3 (a) Find surface area of the glass to manufacture an electric bulb shown in **fig. 4,** using first theorem of Pappu-Guldinus. **07**

OR

(a) Show that moment of inertia about horizontal centroidal axis of T section shown in **fig. 5** is 3.1422×10^6 mm^4. **05**

Also find radius of gyration about horizontal centroidal axis. **02**

Q.3 (b) For a lifting machine experiment, the velocity ratio is found to be 10. The efforts required (P) to raise the respective loads (W) are shown in the table below.

W (N)	25	50	100	150	200	300	400
P (N)	6	9	16	20	26	38	50

Plot graphs on a single graph paper for

i) load v/s effort and develop law of machine. **04**

ii) load v/s efficiency and show maximum efficiency on it. **03**

OR

(b) A 40kg mass is placed on the inclined plane, making 30^0 with horizontal, as shown in **fig. 6.** A push P is applied parallel to the plane. If co-efficient of static fiction between the plane and the mass is 0.25, find the maximum and the minimum values of P between which the mass will be in the equilibrium. **07**

Q.4 (a) A rigid horizontal bar AB of negligible weight is hinged at A and supported by 1.2 m long steel rod and 2.4 m long brass rod, both are rigidly fixed at top, as shown in **fig. 7.** A load of 48kN is applied at B. The areas of cross section of the steel and brass rods are 850 mm^2 and 650 mm^2 respectively find

i) load carried by each rod, **04**

ii) stress in each rod, **02**

iii) reaction at the hinge A. **01**

Take $E_s = 200$GPa, $E_b = 80$GPa.

OR

(a) A Steel bar is subjected to tensions as shown in **fig. 8.** Determine change in volume of the bar, if $E_s = 200$GPa and $\mu_s = 0.25$. **05**

In order that there is no change in volume, what should be the revised value of load along X axis? **02**

Q.4 (b) Determine load P such that the reactions at A & B are equal for the beam shown in **fig. 9.** **02**

Draw shear force and bending moment diagrams and locate point of contra flexure. **05**

OR

(b) A cast iron beam of T section (as per **fig. 5**), is loaded as shown **in fig. 10.** If the tensile and compressive permissible stresses are 40MPa and 70MPa respectively, find the safe point load W. Neglect self weight of the beam. **07**

Q.5 Attempt **Any Two** from the following. **14**

(a) For a beam shown in **fig.10**, is subjected to a point load W equal to 20kN, sketch shear stress distribution diagram at the section where shear force is the maximum. Consider cross section as T as shown in *fig. 5*

(b) A Steel circular bar of 16mm diameter is placed inside a copper tube having internal diameter of 20mm and thickness of 2.5mm as shown in **fig. 11.** Both the ends are rigidly fixed and temperature of assembly is increased by 60^0C.Compute magnitude and nature of stresses produced in each material. Take modulus of elasticity of steel and copper as 200GPa and 100GPa respectively. Consider Co-efficients of thermal expansion (per ^{0}C) for steel and copper as 12 x 10^{-6} and 18 x 10^{-6} respectively.

(c) A point in two dimensional stressed body is shown in **fig. 12.** Determine the magnitudes and directions of principal stresses, using analytical method or by Mohr circle diagram.

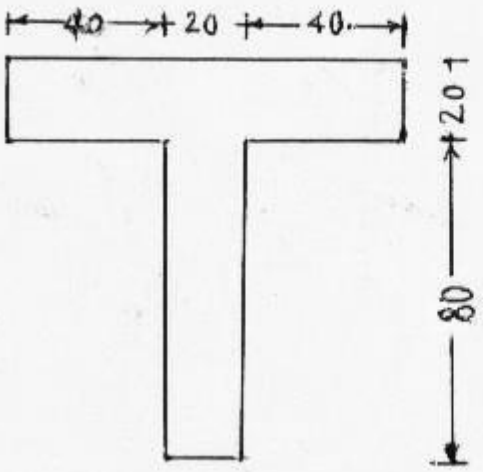

fig.5 Q4 (b) 2nd Alt. & Q5(a)

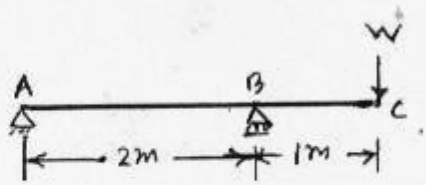

Fig. 10 Q 4(b) 2nd Alt & Q5(a)

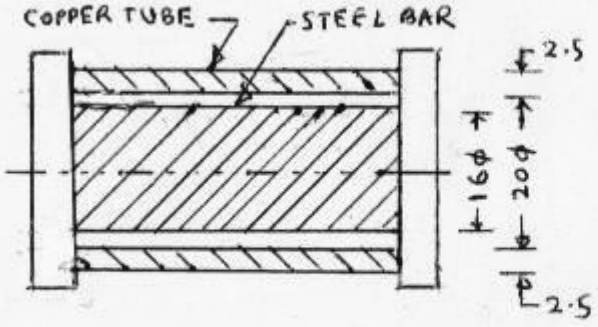

fig.11 Q.5(b)

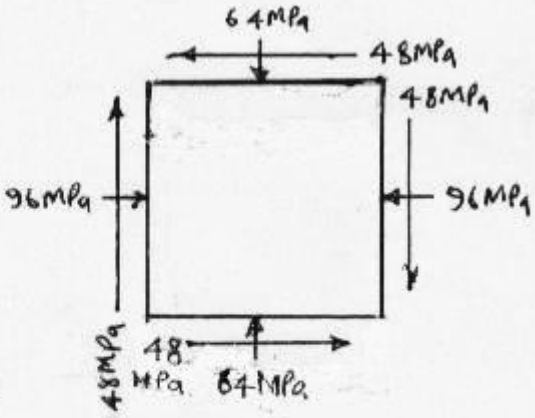

fig.12 Q5(c)

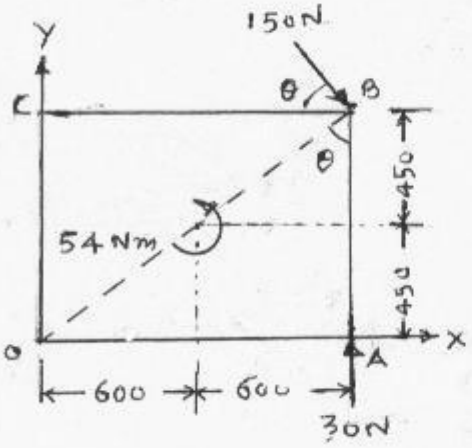

fig. 1 Q. 2(a)

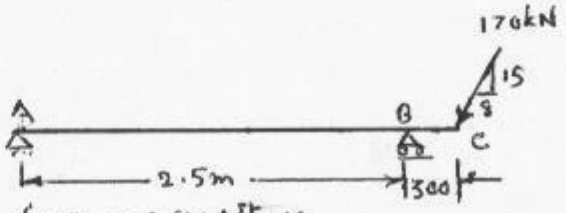

fig 2 Q 2 (b) 1st Alt.

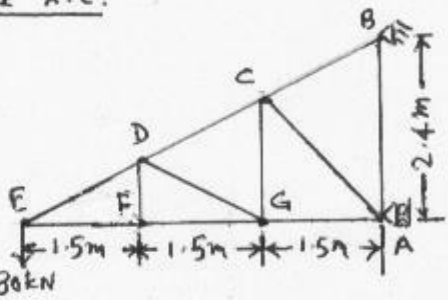

fig 3 Q 2(b) 2nd Alt.

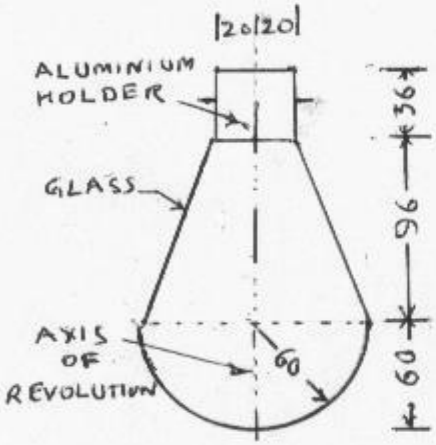

fig 4. Q. 3 (a) 1st Alt.

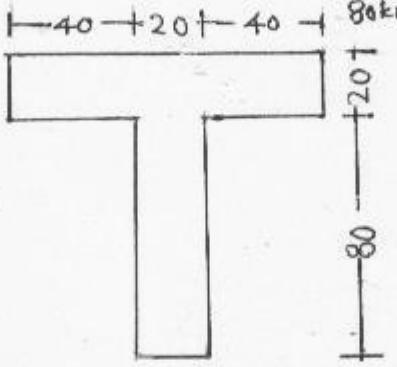

fig 5 Q 3(a) 2nd Alt.

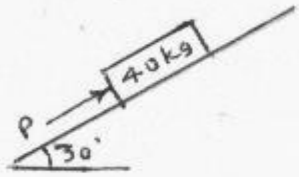

fig. 6 Q. 3 (b) 2nd Alt.

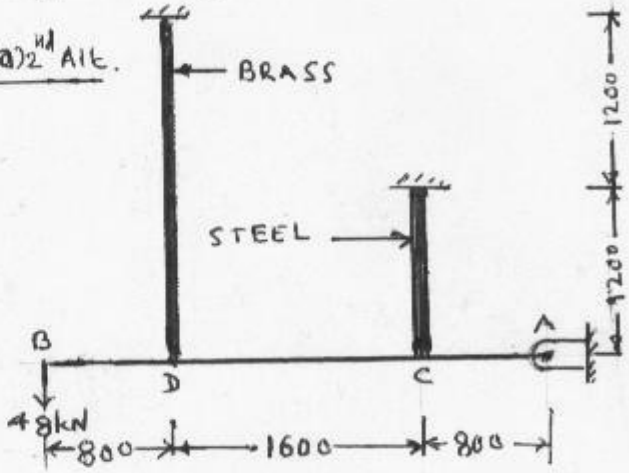

fig 7 Q 4 (a) 1st Alt.

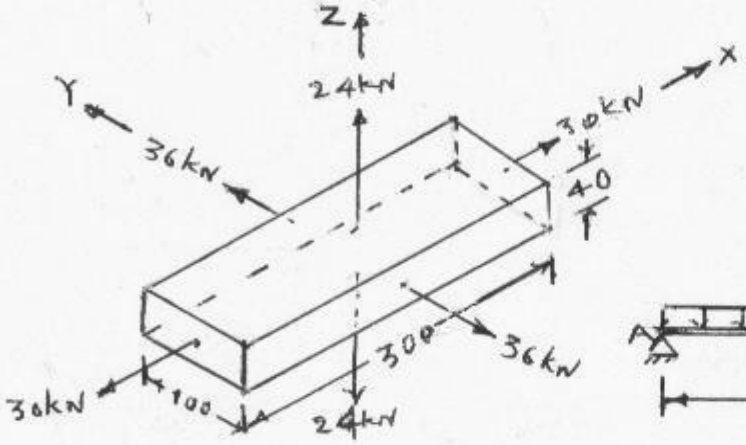

fig 8. Q. 4 (a) 2nd Alt.

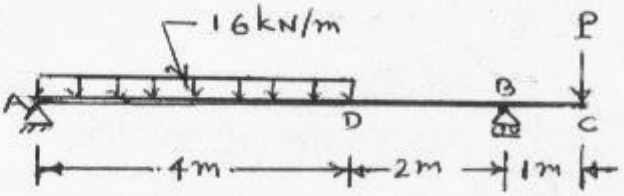

fig 9 Q 4 (b) 1st Alt.