Seat No.: _____ *Enrolment No.:_____*

(MS-3)

GUJARAT TECHNOLOGICAL UNIVERSITY

B.E. all Sem-I Examination December 08/January 09

MECHANICS OF SOLIDS **(110010)**

DATE: 19-12-2008, Friday **TIME: 12.00 to 2.30 p.m.** **MAX. MARKS: 70**

Instructions:

1. ***Attempt all questions.***
2. ***Make suitable assumptions wherever necessary.***
3. ***Figures to the right indicate full marks.***
4. ***Use of graph paper is permitted***

Q.1(a) Fill in the blanks with **most appropriate** answer. **05**

(i) Lateral strains are _____ longitudinal strains. (always less than, sometimes less than, never less than)

(ii) Two forces under equilibrium must be _____(non rectilinear, rectilinear, parallel)

(iii) True relation between dynamic coefficient of friction (μ_d) and static coefficient of friction (μ_s) is _____ ($\mu_d > \mu_s$, $\mu_d = \mu_s$, $\mu_d < \mu_s$)

(iv) _____ is a scalar quantity.(momentum , force , work)

(v) 100 mm = _____ μm (10^5 , 10^6 , 10^{-7})

(b) Do as Directed **09**

(i) Sketch principal planes for the elements subjected to following stresses on two mutually perpendicular planes: (1) Only direct stresses (2) Only shear stresses.

(ii) Differentiate between: (1) Moment of couple v/s moment of force (2) angle of repose v/s angle of friction.

(iii) Draw typical stress – strain plot for a tension test results of mild steel bar. Show salient points on it.

Q.2(a) Derive followings:

(i) Moment of Inertia of rectangular Lamina @ its centroidal axis using first principle. **04**

(ii) Relation between uniformly distributed load, shear force and bending moment with usual notations. **03**

(b) In a differential wheel and axle, the diameter of an effort wheel is 500 mm and the diameter of axles is 200 mm and 100 mm. This machine needs an effort of 550 N to lift 2 kN load and an effort of 800 N to lift 4 kN load. Find .(i) Law of machine (ii) Max efficiency (iii) Effort lost in friction and efficiency at 3 kN load. **07**

OR

(b) A 4 m long ladder has to carry a person of 75 kg weight at 3.5 m distance from floor, along the length of ladder. The self weight of ladder is of 150 N. Find the maximum distance of lower end of ladder from vertical wall so that it does not slide. The coefficient of friction between floor and ladder is 0.3 and that between vertical wall and ladder is 0.2. **07**

Q.3(a) An assembly of steel bars as shown in the fig.1 is in equilibrium. Find force P and the net elongation of the assembly. Take $E_s = 2 \times 10^5$ MPa. **06**

(b) For the beam shown in fig.2, calculate shear force and bending moments at salient points and draw shear force and bending moment diagrams. **08**

OR

Q.3(a) Sketch qualitative shear stress distribution diagrams across the (i) Hollow square (ii) H sections and (iii) T section of the beams. **06**

(b) A mild steel simply supported beam of 3 m span has cross section 20 mm (width) x 50 mm (depth). Find the maximum uniformly distributed load that beam can carry in addition to its self weight, if maximum bending and shear stresses are limited to 150 N/mm^2 and 100 N/mm^2.Self weight of beam is 75N/m. **08**

Q.4(a) Find resultant of a force system shown in fig.3 **04**

(b) Find support reactions for the beam shown in the fig.4 **04**

(c) Find center of gravity of a lamina shown in the fig.5. **06**

OR

Q.4(a) Find the magnitude of the force P, required to keep the 100 kg mass in the position by strings as shown in the fig.6. **03**

(b) Locate zero force members in truss shown in the fig.7. Also find axial forces in remaining members. **05**

(c) Find Moment of Inertia of a lamina shown in the fig.8 about horizontal centroidal axis. **06**

Q.5(a) Prove that maximum shear stress in circular section of a beam is 4/3 times of average shear stress. **04**

(b) Determine change in volume of a steel bar of 100 mm dia.and 500 mm length, when it is subjected to axial pull of 50 kN. Take E_s = 200 GPa and Poisson ratio 0.25 **04**

(c) An assembly made up from Aluminium and Steel bars as shown in the fig.9, is initially stress free at temperature 32° C .The assembly is heated to bring its temperature to 82° C. Find the stresses developed in each bar. The coefficient of thermal expansions is 1.25 x 10^{-5} / ° C & 2.25 x 10^{-5} / °C for steel and aluminium respectively. Take E_s = 200 GPa & E_{al} = 75 GPa. **06**

OR

Q.5(a) A rectangular wooden beam of size 200 x 300 mm is strengthen by steel plates of 10 mm thickness covering entire width of wooden section at top and bottom .Find the moment carrying capacity of the composite section if allowable stresses in wood and steel are 20 MPa and 100 MPa respectively. Take modular ratio as 10. **06**

(b) For an element shown in fig.10 find: (i) principal stresses and location of corresponding principal planes. (ii) Maximum shear stress and location of planes containing it. **08**

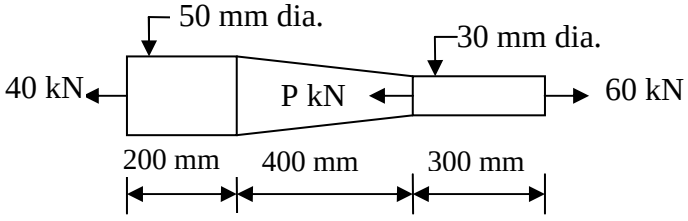

Fig.1 Q.3 (a)

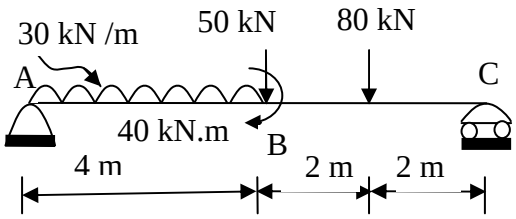

Fig.2 Q.3 (b)

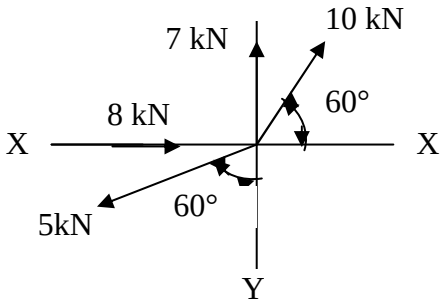

Fig.3 Q-4 (a)

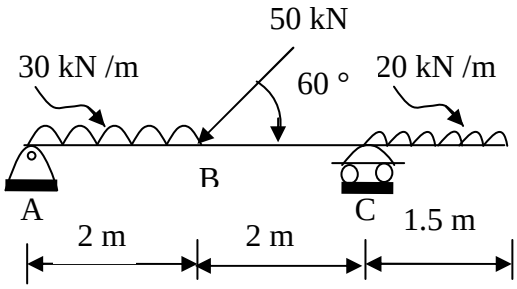

Fig.4 Q.4 (b)

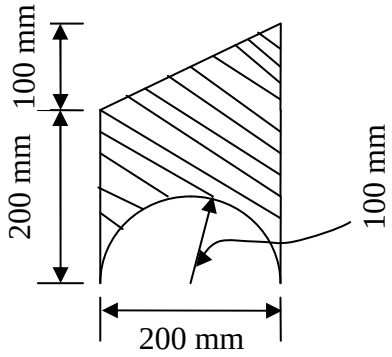

Fig.5 Q-4 (c)

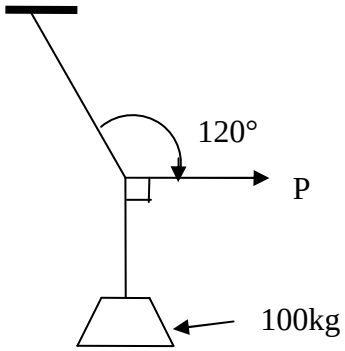

Fig.6 Q-4 (a) OR

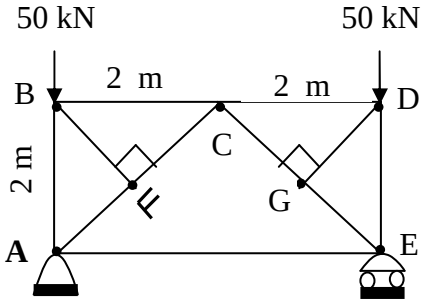

Fig.7 Q-4 (b) OR

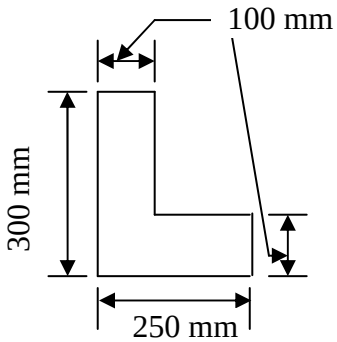

Fig.8 Q-4 (c)OR

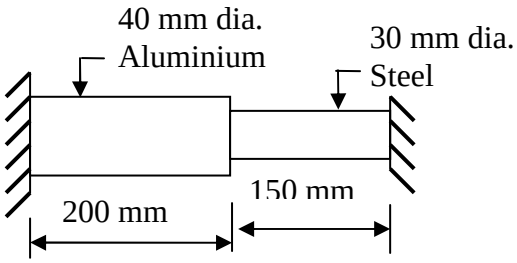

Fig.9 Q.5 (c)

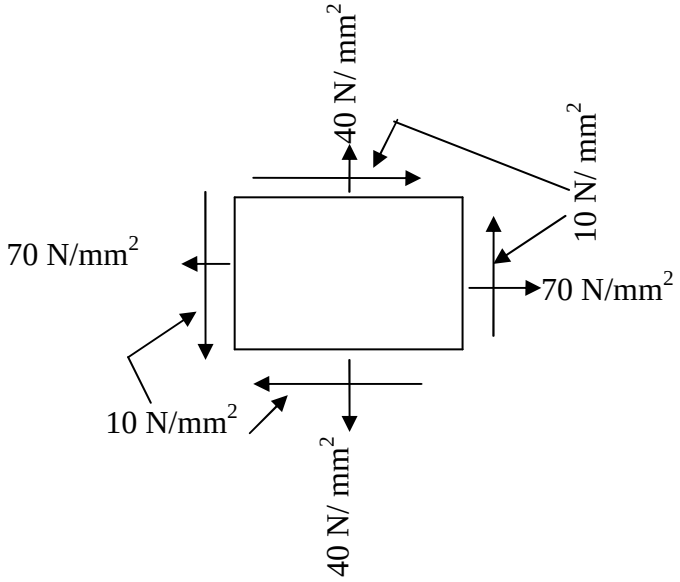

Fig.10 Q-5(b) OR