GUJARAT TECHNOLOGICAL UNIVERSITY
B.E. Sem- 1ˢᵗ Regular Examination January 2011

Subject code: 110010   **Subject Name: Mechanics of Solids**
Date: 12/ 01 /2011   **Time: 10.30 am - 01.00 pm**
                                        Total Marks: 70

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

Q.1 **(a)** Fill in the blanks with the most appropriate answer   **05**
　　i) If arm of couple is doubled, its moment will _____ (be halved , Remain the same , be Doubled)
　　ii) If a ladder is not in equilibrium against a smooth vertical wall, than it can be made in equilibrium by _____(Increasing angle of inclination with vertical, Increasing angle of inclination with horizontal, Increasing the length of ladder)
　　iii) In a cantilever , carrying a load whose intensity varies uniformly from zero at the free end to w per unit run at the fixed end, the S.F diagram changes following a _____ (Linear law, Parabolic law, cubic law)
　　iv) Strength of the beam is mainly depend upon _____ (c.g of the section, its weight, section modulus)
　　v) A body is said to be in equilibrium if it has no linear motion _____ (True, False)

(b) Do as directed   **09**
　　i) A 500 N vertical force is applied to a 60 cm long bar OA hinged at O and inclined at 60° to the horizontal as shown in Fig- 1, Determine
　　　a) The moment of the 500 N force about O
　　　b) The smallest force applied at A which gives the same moment about O
　　　c)At what distance from O, a vertical force of 1500 N force should be applied which gives the same moment about point O
　　ii) What do you understand by a couple ? Prove that the moment of couple does not depend upon the location of the point about which moments of the couple are taken.
　　iii) Resolve 100 N force as shown in Fig- 2 along axis   a-a and b-b.

Q.2 **(a)** i) For coplanar force system prove that " The algebraic sum of the moments of all the forces about any point is equal to the moment of their resultant force about the same point "   **04**
　　ii) Derive equation of centroid for a triangular lamina from its base.   **04**
(b) Two traffic signals are temporarily suspended from a cable as shown   in **Fig- 3.** Knowing that signal B weighs 300 N , determine the weight of the signal at C   **06**
OR
(b) A boat is pulled along the river by two ropes with pulls P & Q inclined at 30° and 40° to the x-axis as shown in Fig -4. Find *a)* P and Q if their resultant R is 1000 N , parallel to x-axis *b*) If P is inclined at 30° to x-axis find the minimum value of Q if R is same.   **06**

Q.3 **(a)** The forces acting on a regular hexagon of side a are shown in Fig – 5. Determine the resultant moment of the system.   **02**
(b) i) Explain self locking machine and Reversible Machine. A machine of velocity ratio 30 can lift a load of 1500 N with the help of 125 N effort. Determine whether the machine is reversible or not.   **06**
　　ii) State the condition for a machine to be reversible with proper justification.
(c) Find the moment of inertia about the y-axis and x-axis for the area shown in Fig -6   **06**

Q.3 **(a)** Determine reaction for the beam loaded and supported as shown in the Fig - 7 **02**

(b) Find forces in the members DE , DB and DC of the truss shown in Fig -8 **06**

(c) A 100 N force acts as shown in Fig- 9 on a 300 N block placed on an inclined plane. The static and kinetic coefficients of friction between the block and the plane are 0.25 and 0.20 respectively. Determine whether the block is in equilibrium, and find the value of the friction force. **06**

Q.4 **(a)** Define the following terms i) Hardness ii) Toughness iii) Strength **03**

(b) State and prove the relationship between shearing stress and rate of change of bending moment at a section in a loaded beam. **05**

(c) A bar ABC is loaded as shown in Fig- 10 , in which portion AB is of uniform section and portion BC is of tapering section. Calculate the value of load P so that the total deformation is 0.3mm. Neglect the deformation due to self weight. Calculate the change in volume of portion AB. Take E= 110 GPa and 1/m=0.25. **06**

OR

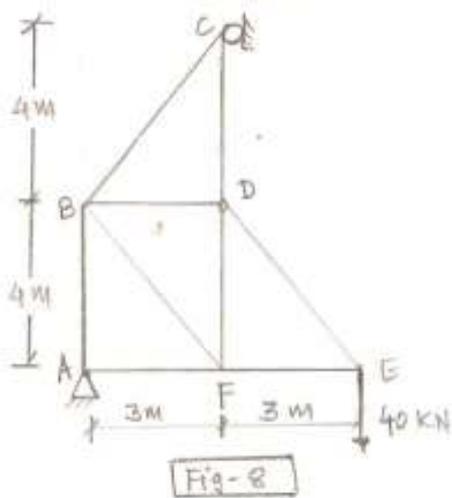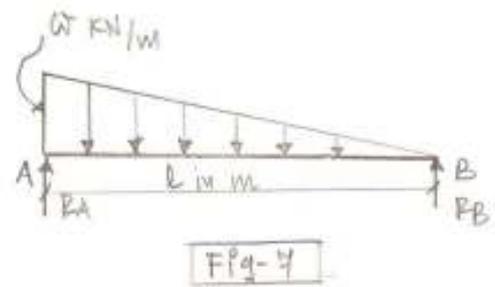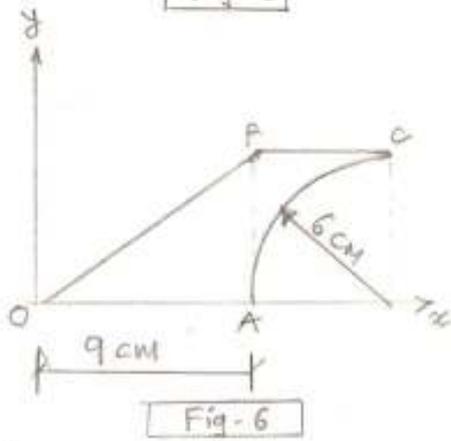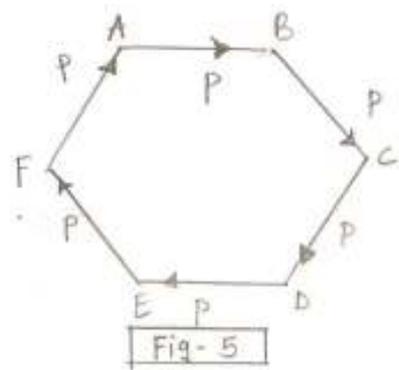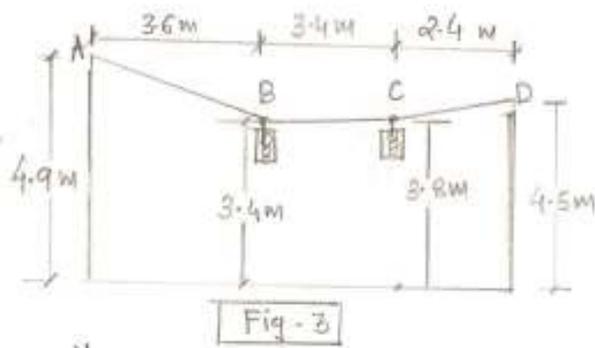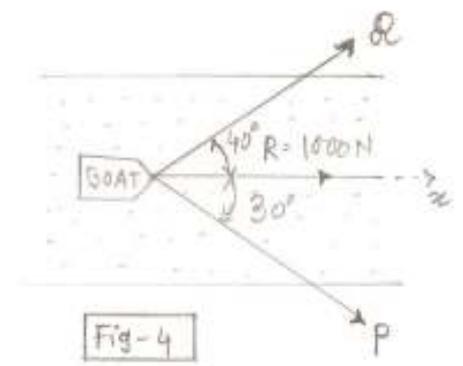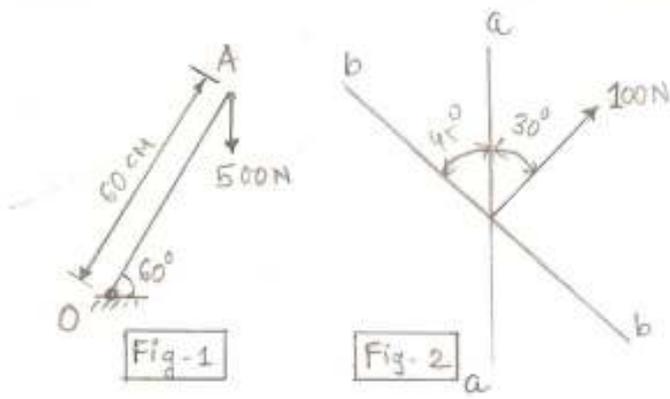**Q.4** **(a)** Explain the terms compressive strain, shear strain, volumetric strain **03**

(b) Fig- 11 shows a beam cross section subjected to shearing force of 200 KN. Determine the shearing stress at neutral axis and sketch the shear stress distribution diagram across the section. **05**

(c) At a point in a strained material, the stresses are as shown in Fig – 12 on two perpendicular planes. Find principal planes and principal stresses. **06**

Q.5 **(a)** Give write up on Izod impact test **03**

(b) Draw shear force and bending moment diagram for the beam loaded and supported as shown in Fig – 13 **05**

(c) A cast iron water main 12 meters long, of 500mm inside diameter and 25 mm wall thickness runs full of water and is supported at its ends. Calculate the maximum stress in the metal if density of cast iron is 7200 kg/m^3 and that of water is 1000 kg/m^3 **06**

OR

Q.5 **(a)** Explain yield stress, ultimate stress and breaking stress with neat sketch for M.S specimen when subjected to tensile loading. **03**

(b) Determine surface area of revolution of the length ABCD revolved about x axis as shown in Fig – 14 **05**

(c) A rectangular block of 50mmX 50mmX300mm is subjected to tensile stress of 200 N/mm^2 along the length in x direction and compressive stresses of 120 N/mm^2 on the remaining all faces in y and z directions. Find the strains produced along x ,y and z directions and calculate change in the volume. If 1/m = 0.25 & E = 200 KN/mm^2 **06**
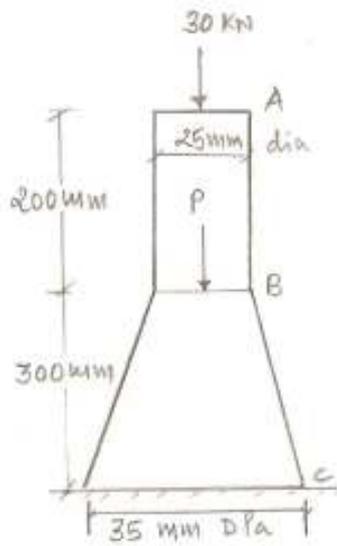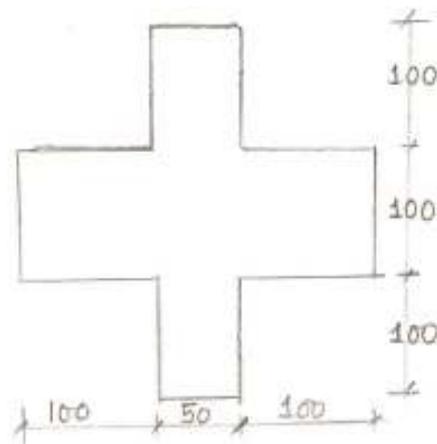
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Fig-1

Fig-2

Fig-4

Fig-3

Fig-5

Fig-6

Fig-7

Fig-8

Fig-9

30 KN

A

25mm dia

200mm

P

B

300mm

C

35 mm Dia
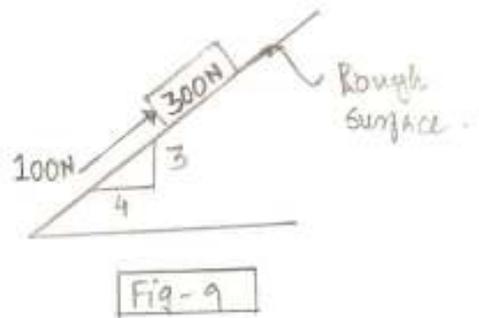
Fig-10

Note:
ALL dimensions are in mm

100

100

100

100   50   100

Fig-11

20 Mpa

40MPa

a_1

b_1

b_2

h_1

45°

100 Mpa

40MPa

a_2 h_2

Fig-12

30KN

20KN

20KN-M

30KN-M

B

E

D

C

A

2 M   2 M   2 M   2 M

Fig-13

Y

700mm

C

B

10mm

50mm

x   A

D   x

Fig-14

4