Seat No.: _____ Enrolment No._____

# GUJARAT TECHNOLOGICAL UNIVERSITY

**B.E. Sem-II [All Branch] examination June 2009**

**Subject code: 110010**

**Subject Name : Mechanics of Solids**

**Date: 18/06/2009** **Time: 10:30am-1:00pm**

**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) Answer the following: (Write complete statements) **04**

i) Splitting of force in given directions is known as _____ of force. (resolution, composition, division)

ii) Poisson's ratio is ratio of _____ (longitudinal to lateral strain, lateral to longitudinal strain, shear stress to shear strain)

iii) For self locking machines, the efficiency of machine should be _____ ( 50%, more than 50%, less than 50%)

iv) Bending moment is _____ at a hinged support. (always maximum, always zero)

(b) Find stress and deformation in each part of rod ABCD shown in **fig.1.** **05**

(c) Find magnitude and direction of resultant of force system shown in **fig. 2.** **05**

**Q.2** (a) Find magnitude, direction and location of resultant of force system with respect to point 'O' shown in **fig. 3.** **07**

(b) Calculate location of centroid of a triangular lamina using first principle. **07**

**OR**

(b) Derive expression for maximum shear stress in a rectangular cross section using first principle. Determine ratio of maximum shear stress to average shear stress. **07**

**Q.3** (a) Explain following terms : **04**

i) Mechanical advantage ii) Velocity ratio

iii) Ideal load iv) Efficiency

(b) Determine forces in members of truss shown in **fig 4**. **05**

(c) A block weighing 250N rest against wall as shown in **fig 5**. A wedge is placed under it. Find out minimum force 'P' required to lift the block. The coefficient of friction at all contacting surfaces is 0.25. Neglect self weight of wedge. **05**

**OR**

**Q.3** (a) Draw characteristic stress-strain curve for mild steel under tension and show salient points on it. **04**

(b) Calculate reactions at support due to applied load on the beam as shown in **fig. 6.** **05**

(c) Draw shear force and bending moment diagram for beam shown in **fig 7.** **05**

**Q.4** (a) What do you understand by pure bending? Write various assumptions made in theory of pure bending. **04**

(b) Find out maximum bending stresses at top and bottom of beam as shown in **fig.8**. **05**

(c) Find out moment of resistance of beam made by attaching 10mmx300mm steel plate on one side of timber section 200 mm x 300 mm. Allowable stress in timber and steel is 7MPa and 150MPa and their modular ratio is 10. **05**

**OR**

**Q. 4** (a) Draw variation of shear stress across the cross section of **04**
i) Hollow rectangle ii) Hollow circle
iii) Hollow triangle iv) H section

(b) Draw shear stress distribution diagram across the cross section of a T beam, having flange 200x20mm and web 10x300mm and carrying shear force 100kN. **05**

(c) Find out uniformly distributed load which can be safely applied to a cantilever beam having span 2m. The beam has rectangular cross section 200x300mm. The allowable bending stress and allowable shear stress in beam material is 15MPa and 10MPa respectively. **05**

**Q.5** (a) What do you understand by principal planes? Write expression to determine magnitude of principal stress and maximum shear stress and, location of planes carrying them for a generalized stress condition. **04**

(b) Derive expression to determine stress on an inclined plane when an element carries tensile stress and compressive stress in perpendicular directions. **05**

(c) An element is loaded by tensile stress 5MPa and compressive stress 4MPa in perpendicular directions alongwith shear stress 3MPa as shown in **fig 9.** Calculate normal, tangential and resultant stress on a plane making $30^0$ angle in anticlockwise direction with the plane carrying tensile stress. **05**

**OR**

**Q.5** (a) Derive relationship between modulus of elasticity, modulus of rigidity and Poisson's ratio. **04**

(b) Give statement of **05**
i) Varignon's theorem ii) Parallel and Perpendicular axis theorem
iii) Pappus Guldinus Theorem

(c) A composite bar madeup of steel and copper rods, connected in series. The ends of composite bars are fixed. Find the stress developed in steel and copper due to increase in temperature by $50^0$C. Other relevant data are given below **05**

| | Copper | Steel |
|---|---|---|
| • Length | 1.2 m | 1.0 m |
| • Diameter | 30 mm | 30 mm |
| • Coefficient of thermal expansion | $17x10^{-6}/^0C$ | $12x10^{-6}/^0C$ |
| • Modulus of elasticity | $0.8x10^5$ MPa | $2.0x10^5$ MPa |

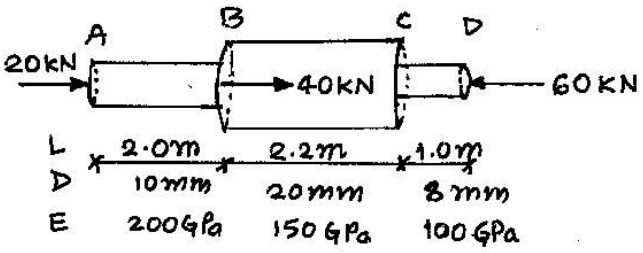


FIG 1. Q 1 (b)

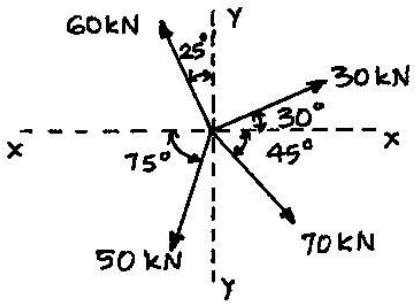


FIG 2. Q 1(c)

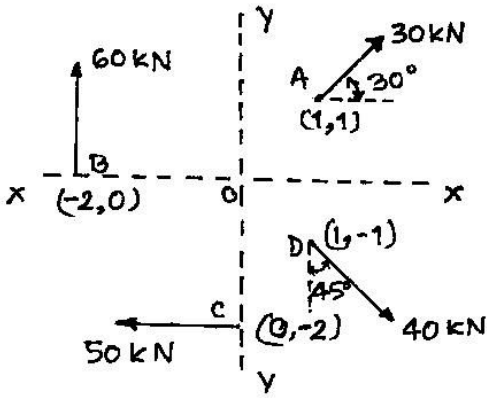


FIG 3. Q 2 (a)

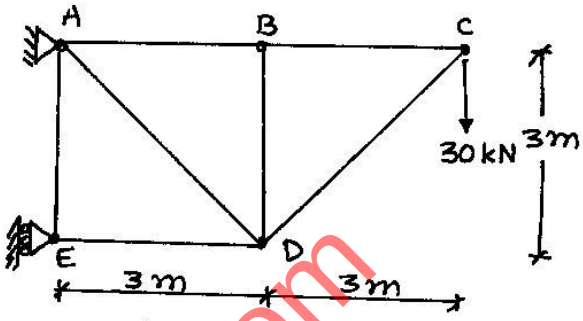


FIG 4 Q.3(b)

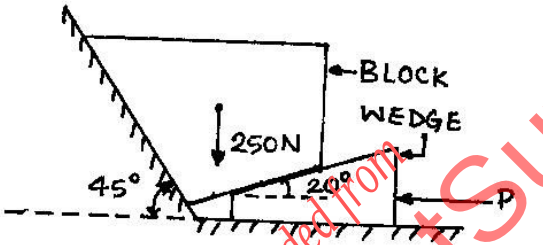


FIG 5 Q 3(c)

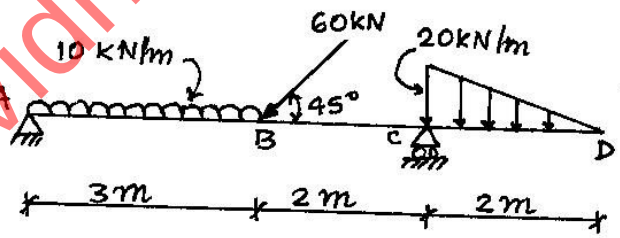


FIG 6. Q 3(b) OR

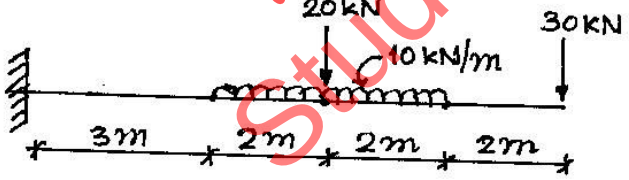


FIG 7 Q 3(c) OR

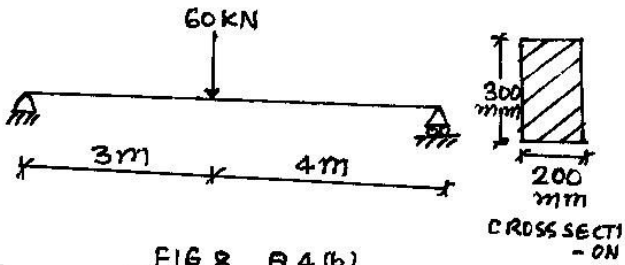


FIG 8 Q 4 (b)

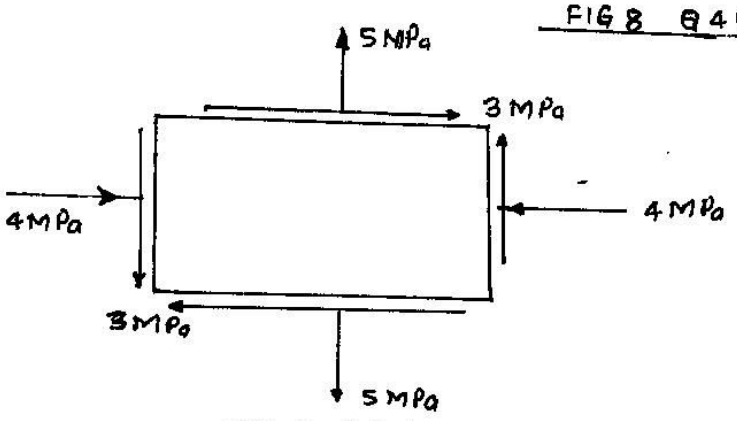


FIG 9 Q.5(c)