Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

P.D.D.C. Sem- I Regular / Remedial Examination January. 2011

Subject code: X11901
Subject Name: STRENGTH OF MATERIALS

Date: 11 / 01 /2011 **Time: 10.30 am – 01.00 pm**
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)** i) Differentiate between:- **04**
- Brittle materials & Ductile materials
- Brinell Hardness Test & Rockwell Hardness Test

ii) Define 'Hardness'. During Brinell Hardness Test on Mild Steel specimen, the diameter of impression was observed to be 3.1 mm with a 10 mm diameter steel ball as an indenter. Compute the Brinell Hardness No. **03**

(b) i) Define Toughness, Resilience & Endurance Limit. **03**

ii) In a tension test on Mild Steel specimen with initial diameter of 20 mm and length of 200 mm, following readings were recorded: **04**
- i) Diameter after failure = 14.5 mm
- ii) Length after failure = 235 mm
- iii) Failure load = 70 kN

Compute % contraction, % elongation, True stress at failure & engineering stress at failure.

Q.2 **(a)** i) A load of 200 N falls through a height of 25 mm on a collar rigidly attached to the lower end of a vertical bar 2 m long and of 300 mm^2 cross-sectional area. The upper end of the vertical bar is fixed. Determine the maximum instantaneous stress and elongation induced as well as the strain energy stored in the bar. Take E = 2 x 10^5 MPa. **05**

ii) A steel bar of 50 mm diameter and 4 m long is subjected to an axial tensile force of 50 kN. Determine the maximum stress induced and the strain energy stored in the bar if [i] the load is gradual and [ii] the same load is suddenly acting. Take E = 2 x 10^5 MPa. **02**

(b) Two plates 10 mm thick are joined by single riveted lap joint. The diameter of the rivets is 20 mm and pitch of 60 mm. Determine strength and efficiency of the riveted joint. Consider permissible tensile stress of plate material = 125 MPa, permissible shearing stress of rivet material = 80 MPa & permissible crushing stress of rivet material = 160 MPa. **07**

OR

(b) i) State advantages and disadvantages of the welded joints. **04**

ii) With neat sketches explain different types of the welded joints. **03**

Q.3 **(a)** For a solid circular shaft, with usual notations, derive the 'Torsion Formula' and state the assumptions used for the derivation of the same. **07**

(b) Design a solid circular shaft to transmit 250 kw power at 70 rpm. The shear stress must not exceed 80 MPa and the angle of twist must not exceed 1.5° in a length of 2.0 m. Take G = 8 x 10^4 MPa. **07**

OR

Q.3 **(a)** A solid circular shaft of diameter 110 mm has to transmit 150 kw power at 70 rpm. Compute the maximum shear stress induced and the angle of twist over the length of 1.0 m of the shaft. Take G = 8 x 10^4 MPa. **07**

(b) Two shafts of the same material and of same lengths are subjected to the same torque. First shaft is solid shaft and second shaft is hollow shaft with Di=0.6 Do. If maximum shear stress developed in each shaft is equal, compare weights of both the shafts. **07**

Q.4 **(a)** For an element shown in Fig.1, compute (i) principal stresses and their inclinations (ii) maximum shearing stress and (iii) normal and tangential stresses on a plane x-x making inclination of 30˚ with the vertical. **07**

(b) A steel plate of size 200 mm x 200 mm is subjected to stresses as shown in Fig. 2. A circle of 50 mm diameter is drawn on the plate. If for the steel plate E = 2 x 10^5 MPa and Poisson's ratio = 0.25, compute lengths of major and minor axes after the deformation of the plate. **07**

OR

Q.4 **(a)** For an element shown in Fig.3, compute (i) principal stresses and their inclinations (ii) maximum shearing stress and (iii) normal and tangential stresses on a plane x-x making inclination of 30˚ with the vertical. **07**

(b) A solid circular shaft of diameter 80 mm and 2 m length has to transmit 100 kw power at 60 rpm. The shaft is in cantilever condition with a transverse downward force of 20kN at the free end. Compute the (i) principal stresses and (ii) maximum shearing stress developed in shaft due to combined bending and torsion effect. **07**

Q.5 **(a)** Draw shear force and bending moment diagrams for the beam shown in Fig.4. **07**

(b) For the beam shown in Fig.5 determine maximum slope and deflection at the free end by using Macaulay's method. Take EI = 2 x 10^4 kN-m^2. **07**

OR

Q.5 **(a)** Draw shear force and bending moment diagrams for the beam shown in Fig.6. **07**

(b) Draw bending moment diagram for the continuous beam shown in Fig.7. Use moment distribution method. **07**

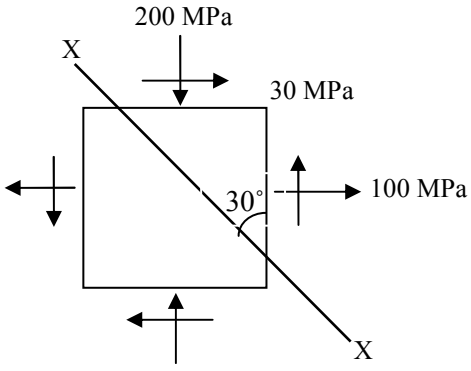

Fig. 1 Q.4 (a)

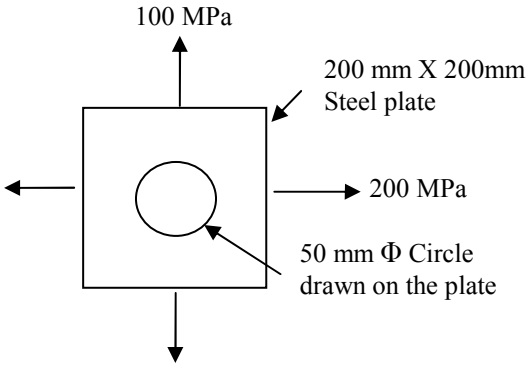

Fig. 2 Q.4 (b)

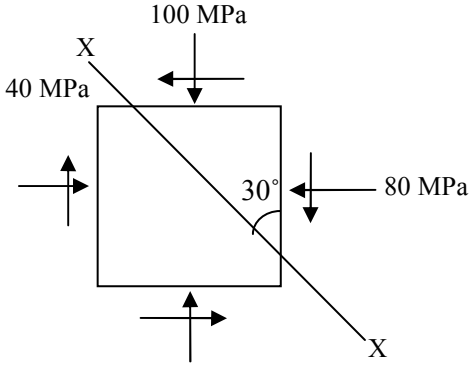

Fig. 3 Q.4 (a) OR

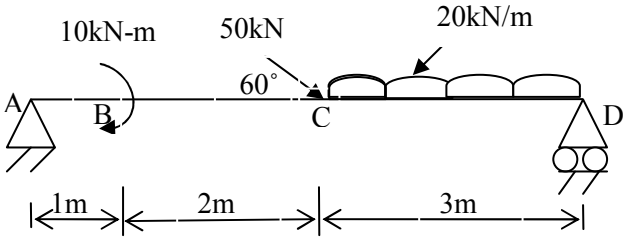

Fig. 4 Q. 5 (a)

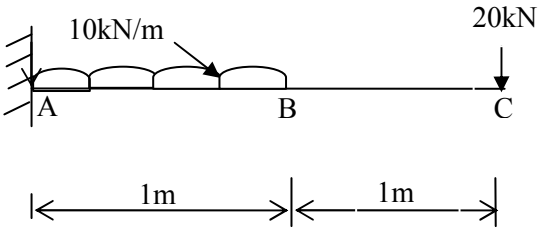

Fig. 5 Q. 5 (b)

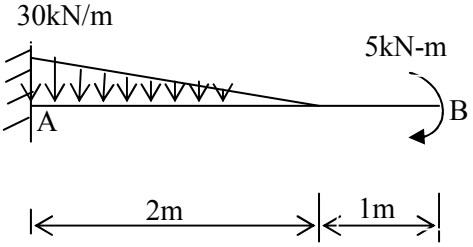

Fig. 6 Q. 5 (a) OR

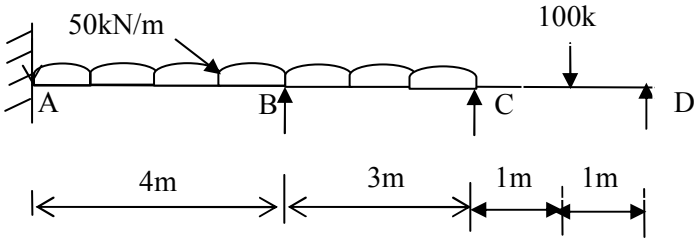

Fig. 7 Q. 5 (b) OR

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