

GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER-III (NEW) EXAMINATION – SUMMER 2021****Subject Code:2130003****Date:06/09/2021****Subject Name:Mechanics of Solids****Time:10:30 AM TO 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.
4. Simple and non-programmable scientific calculators are allowed.

- Q.1** (a) State and explain Varignon's theorem. **03**
- (b) Differentiate between following : **04**
- 1) Co-planar & Non coplanar force system
 - 2) Concurrent & Non concurrent force system
 - 3) Resolution & composition of force
 - 4) Resultant & Equilibrant
- (c) A bar of 20 mm diameter is subjected to a pull of 50kN. The measured extension on gauge length of 250 mm is 0.12 mm and change in diameter is 0.00375 mm. Calculate: **07**
- (i) Young's modulus (ii) Poisson's ratio and
(iii) Bulk modulus.

- Q.2** (a) Explain following terms: **03**
- (i) Shear force (ii) Bending moment
(iii) Point of contra flexure
- (b) Find out support reactions for the beam as shown in fig. **04**

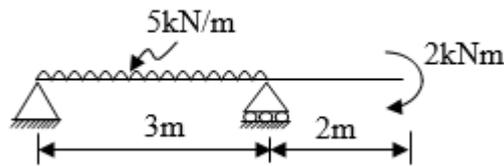


fig.1

- (c) Draw Shear force and Bending Moment diagram for the beam shown in fig. 1 **07**

OR

- (c) The bar shown in fig.2, find the diameter of middle portion .Stress is limited to 130 MN/m^2 . Find also the length of middle portion if the total elongation of bar is 0.15mm. Take $E = 200 \text{ GN/m}^2$. **07**

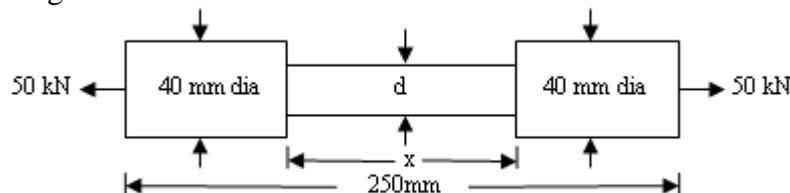


fig.2

- Q.3 (a) Define:** **03**
- (1) Centroid,
 - (2) Center of gravity,
 - (3) Center of mass.
- (b) State and explain Pappus-Guldinus theorem I & II** **04**
- (c) Find the centroid of the Lamina shown in fig.3 and moment of Inertia @ its centroid.** **07**

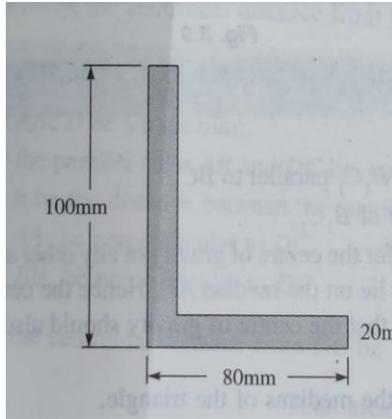


fig.3

Consider thickness of web and flange as 20 mm.

OR

- Q.3 (a) Explain with suitable figure.** **03**
- (a) Types of support,
 - (b) Types of load,
 - (c) Types of beam.
- (b) Find resultant for the given force system as shown in fig.** **04**

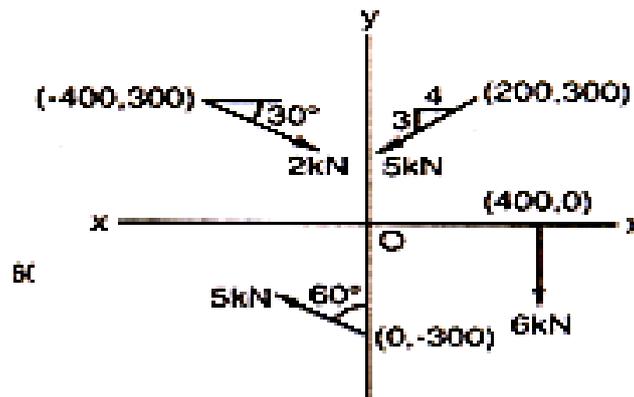


fig.4

- (c) Draw only shape of shear stress distribution diagram for the following sections :** **07**
- T section , (ii) symmetrical I section , (iii) Triangular section , (iv) H section, (v) Rectangular section (vi) circular section (vii) L section.
- Q.4 (a) Explain section modulus – Z.** **03**
- (b) Enlist assumptions made in theory of pure bending.** **04**
- (c) A steel beam of hollow section of outer side 100 mm and inner side 80 mm is used on a span of 4 meter. Find the uniformly distributed load that beam can carry if the bending stress is not to exceed 120 N/ mm².** **07**

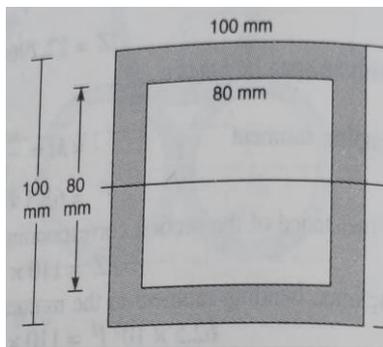


fig.5

OR

- Q.4 (a)** Derive relation between modulus of Elasticity E and modulus of Rigidity C , $E = 2C(1 + \mu)$. **03**
- (b)** A rod of diameter 10 mm and length 2.0 meter is heated from 40°C to 200°C . Find **04**
- Change in length when freely expanded
 - Stress, when completely restrained.
- Take $E = 2 \times 10^5 \text{ N/mm}^2$, $\alpha = 12 \times 10^{-6} \text{ per } ^\circ\text{C}$
- (c)** A short concrete column 300 mm x 300 mm in section is carrying axial load of 360 kN. The column is strengthened by four, 12 mm diameter steel bars each one at corner. Calculate stresses in concrete and steel. **07**
Take $E_c = 14 \text{ GPa}$ and $E_s = 210 \text{ GPa}$.
- Q.5 (a)** Define coefficient of friction, Angle of friction, Angle of Repose. **03**
- (b)** Enlist all the equations related to Principal planes and principal stresses. **04**
- (c)** Two mutually perpendicular planes of an element of material are subjected to direct stresses of 12 MN/m^2 (tensile) and 4 MN/m^2 (comp.) and shear stress of 6 MN/m^2 . Find (i) magnitude and direction of principal stresses and (ii) Magnitude of the normal and shear stresses on a plane on which the shear stress is maximum. **07**
- OR**
- Q.5 (a)** Derive the relation $T/I_p = C\theta/L$ for circular shaft with usual notations. **03**
- (b)** Enlist laws of static and dynamic friction. **04**
- (c)** A steel shaft of diameter 25 mm carries a twisting moment 10 kNm. Find the maximum shear stress in shaft. Also calculate angle of twist if length of shaft is 2.0 meter. And modulus of rigidity is $0.8 \times 10^5 \text{ N/m}^2$. **07**
