Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–III (NEW) EXAMINATION – SUMMER 2024

Subject Code:2130003 Date:16-07-2024

Subject Name: Mechanics of Solids

Time:10:30 AM TO 01:00 PM Total Marks:70

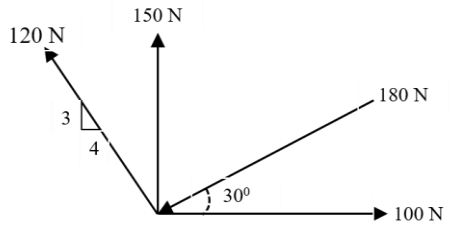
Instructions:

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)** Enumerate various types of supports with neat symbolic sketches, showing possible reactions. **03**

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

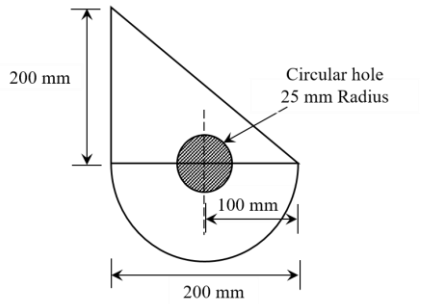
(c) Define Force and discuss its characteristics. Also find the magnitude and direction of resultant force of a force system shown in fig. **07**



Q.2 **(a)** Briefly explain: (i) Coefficient of friction (ii) Pappus-Guldinus theorem I & II **03**

(b) Differentiate: Moment of a force and couple. **04**

(c) Find out centroid of the Lamina shown in fig. **07**



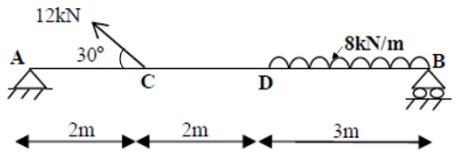
OR

(c) A steel rod 35 mm in diameter is inserted inside a copper tube of 40 mm internal diameter and 45 mm external diameter, the ends are rigidly connected together. If temperature of composite assembly is raised by 65 ^{0}C, What will be the stresses in steel and copper? **07**

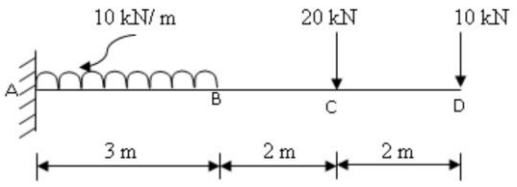
Take E_S = 200 Gpa, E_C = 100 Gpa, α_S = 12 x 10^{-6} per ^{0}C, α_C = 18 x 10^{-6} per ^{0}C

Q.3 **(a)** Define: (i) Shear Force (ii) Point of contraflexure (iii) Over hanging beam **03**

(b) A beam is loaded as shown in Fig. Determine the reactions at supports. **04**



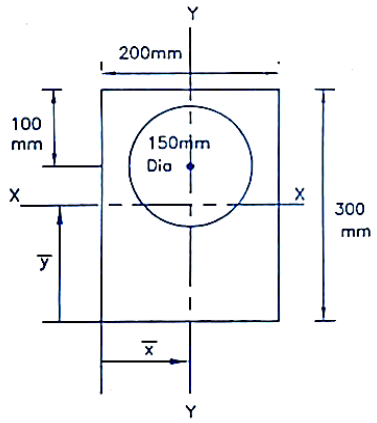
(c) Draw shear force diagram and bending moment diagram for beam shown in fig. **07**



OR

Q.3 **(a)** Give statement: (i) Parallel axis theorem (ii) Perpendicular axis theorem. **03**

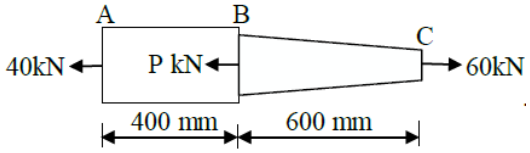
(b) Determine moment of inertia about horizontal centroid axis for the section shown in fig. **04**



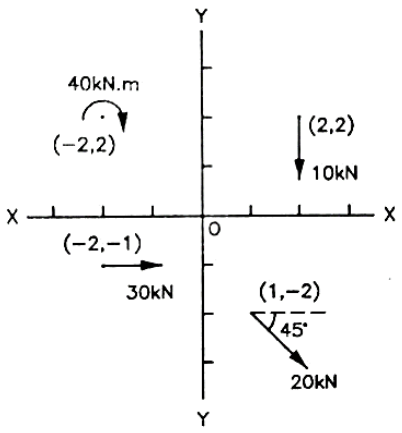
(c) A uniform ladder, of length 5 m, is supported by a horizontal floor at 'A' and a vertical wall at 'B' and makes an angle of 60° with the horizontal. Find the maximum distance 'x' up the ladder at which a man of weight 700 N can stand without causing slipping of the ladder. The coefficient of friction between floor & ladder and wall & ladder is 0.3. Neglect the weight of ladder. **07**

Q.4 **(a)** Define: (i) Poisson's ratio (ii) Lateral strain (iii) Composite bar **03**

(b) A stepped circular bar ABC is axially loaded as shown in fig. (i), is in equilibrium. The diameter of part AB is 50 mm throughout its length, whereas diameter part BC is uniform decreasing from 40 mm at B to 30 mm at C. Determine (i) magnitude of unknown force 'P' (ii) stress in part AB and (iii) change in length of part BC. Take modulus of elasticity = 2 x 10^5 N/mm^2. **04**



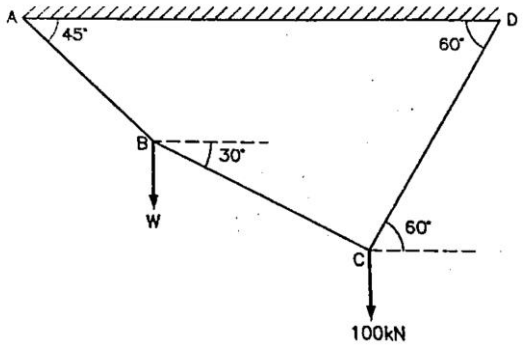
(c) A force system is shown in fig. determine resultant of this system and replace this resultant by equivalent force-couple system at origin. **07**



OR

Q.4 **(a)** State: (i) Law of Parallelogram of Forces (ii) Lami's Theorem. **03**

(b) A weight W is suspended from the ceiling with the help of rope as shown in fig. Find value of weight W. **04**



(c) A tension test was performed on a steel specimen of 16 mm diameter in which an axial load of 2 kN produced an elongation of 0.05 mm in a length of 80 mm, while diameter suffered a compression of 0.0035 mm. Calculate the values of change in volume, Poisson's ratio, modulus of elasticity and modulus of rigidity. **07**

Q.5 **(a)** Define: (i) Neutral Axis (ii) Torque (iii) Torsional Rigidity **03**

(b) External and internal diameter of a propeller shaft are 400 mm and 200 mm respectively. Find maximum shear stress developed in the cross-section when a twisting moment of 50 kN.m is applied. Take modulus of rigidity C = 0.8×10^5 N/mm^2. If span of shaft is 4 m, also find twisting angle of shaft. **04**

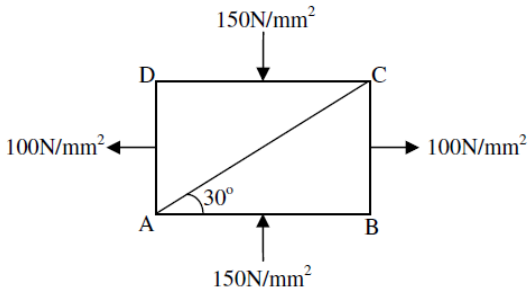
(c) A cast iron water pipe of 500 mm inside diameter and 20 mm thick, is supported over a span of 10 meters. Find the maximum bending stress in the pipe metal, when the pipe is running full. Take density of cast iron = 70.6 kN/m^3 and water = 9.8 kN/m^3. **07**

OR

Q.5 **(a)** Draw shear stress distribution across the following section. (1) Hollow rectangular (2) H-section (3) T-section **03**

(b) Determine maximum shear stress in a cantilever beam of length 2 m. the beam carries an udl of 8 kN/m over the entire length of 2 m and a concentrated vertical downward load of 25 kN at the free end of cantilever. The cross-section of the beam is a rectangle of size 350 mm deep and 250 mm wide. **04**

(c) The direct stresses at a point in the strained material are 150 N/mm^2 compressive and 100 N/mm^2 tensile as shown in fig. There is no shear stress. Find the normal and tangential stresses on the plane AC. Also find the resultant stress on AC. **07**



****