Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–III (NEW) EXAMINATION – WINTER 2021

Subject Code:2130003 Date:17-02-2022

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.**

			MARKS
Q.1	**(a)**	State and explain the Lami's theorem	**03**
	(b)	Differentiate between following : 1) Resolution & composition of force, 2) Concurrent & Non concurrent force system	**04**
	(c)	The following forces are acting at a point; find the magnitude and direction of the resultant force. 1. 850kN acting towards North. 2. 1200kN acting towards South-West 3. 800kN acting 30° South of East 4. 550kN acting towards East	**07**
Q.2	**(a)**	Define : Particle, Rigid body & Deformable body	**03**
	(b)	Using Pappus-Guldinus theorems, determine the lateral area (surface area) and volume of the right circular cone of base radius 'r' and altitude 'h'.	**04**
	(c)	Two cylinders A and B rest in a box as shown in Fig 1. Cylinder A has a diameter 300 mm and weight 1200 N and cylinder B has a diameter 200 mm and weight 360 N. The box is 450 mm wide at the bottom. Assume that all surfaces are smooth. Find the reactions at the supporting surface.	**07**
		OR	
	(c)	Find the moment of inertia about base of the plane lamina shown in Fig.2	**07**
Q.3	**(a)**	Define : (i) Theorem of Parallel Axes (ii) Theorem of Perpendicular Axes (iii) Radius of Gyration	**03**
	(b)	A steel tube of 2 m length is subjected to 50° C rise in temperature. Determine free natural expansion and stress developed in the tube, if expansion is prevented. Take Es = 200 GPa and $\alpha s = 12 \times 10^{-6}/^{\circ}C$	**04**
	(c)	A short concrete column 450 mm x 450 mm has four steel rods of 25 mm diameter embedded in it. Find the stresses in steel and concrete when the total load on column is 1000 kN. Find also the adhesive force between the steel and concrete. Take Ec= 13.6 GPa and Es= 205 GPa.	**07**
		OR	
Q.3	**(a)**	Derive relation between young's modulus (E) and bulk modulus (K) with usual notation	**03**
	(b)	A circular rod of diameter 25 mm and 450 mm long is subjected to a tensile force of 50 kN. The modulus of elasticity for steel may be taken as 100 kN/mm^2. Find stress, strain and elongation of the bar due to applied load.	**04**
	(c)	A member ABCD is subjected to point loads P1, P2, P3 and P4 as shown in Fig 3. Calculate the force P2 necessary for equilibrium if P1= 10 kN, P3=40 kN and P4=16 kN. Find elongation of member and stress in part. Taking modulus of elasticity as $E = 2 \times 10^5$ MPa.	**07**

Q.4	**(a)**	Derive the relation T/Ip = Cθ/L for circular shaft with usual notations.	**03**
	(b)	Determine the centroid of lamina shown in Fig.4	**04**
	(c)	A square beam 30 mm x 30 mm in section and 3 m long is supported at the ends. The beam fails when a point load of 400 N is applied at the center of the beam. What uniformly distributed load per meter length will break cantilever beam of the same material 40 mm wide & 60 mm deep and 3 m long?	**07**

OR

Q.4	**(a)**	State and explain the assumption made in Simple theory of pure bending	**03**
	(b)	Determine support reaction for the given beam shown in Fig.5	**04**
	(c)	Draw shear force and bending moment diagram of the beam shown in Fig.6, finding values at all important points on the beam.	**07**

Q.5	**(a)**	Define coefficient of friction, Angle of friction, Angle of Repose.	**03**
	(b)	A circular beam 200 mm dia. is subjected to shear force of 19 KN. Calculate the value of maximum shear stress and sketch the variation of shear stress along the depth of beam.	**04**
	(c)	A solid shaft is required to transmit 120 kW power at 200 r.p.m. Find the suitable diameter of shaft if maximum torque transmitted in each revolution exceeds the mean by 20%. Take allowable shear stress as 70 N/ mm^2 for the material of the shaft.	**07**

OR

Q.5	**(a)**	Define principal planes and principal stresses.	**03**
	(b)	Two mutually perpendicular planes of an element of material are subjected to direct stresses of 16.5 MN/m^2 (tensile) and 4.5 MN/m^2 (compressive) and shear stress of 7 MN/m^2 . Find magnitude and direction of principal stresses	**04**
	(c)	A uniform ladder of weight 250 N, and length 5 m is placed against a vertical wall in position where its inclination with vertical is 30°. A man weighing 800N climbs the ladder. At what position will he induced slipping. Take μ = 0.2 at all contact surface.	**07**

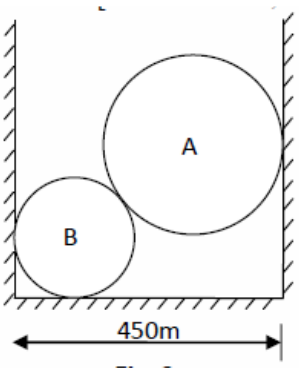

Fig.1

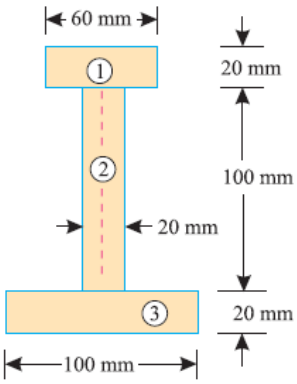

Fig.2

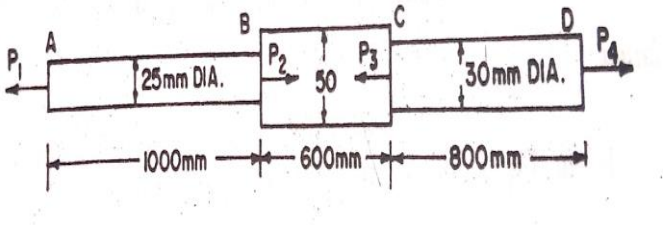

Fig.3

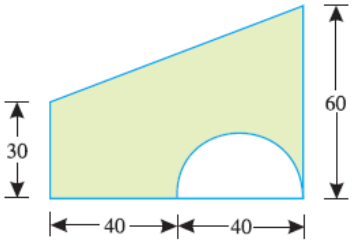

Fig.4

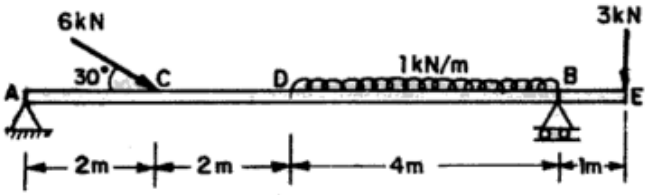

Fig.5

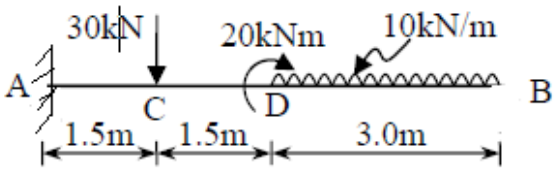

Fig.6