Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–III(New) • EXAMINATION – WINTER 2016

Subject Code:2130003 Date:31/12/2016

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.**

			MARKS
Q.1		**Short Questions:**	**14**
	1	Two unlike parallel forces, will form a_____. (Couple, Bending Moment, Shear force).	
	2	A particle is said to be in _____ when the resultant force acting on it is zero. (Equilibrium, Stable, Unstable)	
	3	The process of finding components of a force is called _____of forces. (Resolution, Splitting, Composition)	
	4	Define Law Of Transmissibility.	
	5	The Relation between Shear force and Bending moment is _____.	
	6	A cylinder is a surface of revolution generated by revolving a _____line about a fixed axis. (Straight, circular)	
	7	Co-efficient of static friction will always be _____than the coefficient of kinetic friction. (greater, equal, lesser)	
	8	The maximum value of Poisson's ratio for most of the engineering material is____. (0.5, 1,1.5)	
	9	Young's modulus of elasticity for a perfectly rigid body is_____.(zero, infinity)	
	10	The point where the Shear force is maximum, slope of the bending moment is_____. (maximum, minimum, zero)	
	11	In a beam of I-section, the maximum shear stress is carried by the_____.(web, flange)	
	12	A t the point of contraflexure _____changes it's sign. (shear force, bending moment, axial force)	
	13	Shear stresses on principal planes are_____.(zero, maximum, minimum)	
	14	For an element in pure shear, principal planes are oriented at_____ to the axis. (45^0, 90^0)	
Q.2	**(a)**	State and explain Varignon's theorem.	**03**
	(b)	Two tensile forces acting at an angle 120^0 between them. The bigger force is 50 kN. The resultant is perpendicular to the smaller force. Find the smaller force and the resultant force.	**04**
	(c)	Two smooth sphere of weight 100 N each and radius 20 cm are in equilibrium in horizontal channel of width 72 cm as shown in figure 1. Find reactions at the contact surfaces A, B, and C. Assume sides of channel smooth.	**07**
		OR	
	(c)	At a point in a strained material the state of stress is as shown in figure 2. Determine (i) Location of Principal planes (ii) Principal	**07**

stresses. (iii) Maximum shear stress and location of plane on which it acts.

Q.3 **(a)** For pure bending, prove that the neutral axis coincides with the centroid of the cross section. **03**

(b) A circular pipe of 100 mm external diameter and 80 mm internal diameter is used as a Simply Supported beam of span 4 m. Find the safe concentrated load that the beam can carry at the mid point, if the permissible stress in the beam is 120 N/mm^2. **04**

(c) A solid steel shaft is subjected to a torque of 45 kN m. If the angle of twist is 0.5^0 per meter length of shaft and shear stress is not to exceed 90 N/mm^2. Find: (i) Suitable diameter of shaft (ii) Final maximum shear stress and angle of twist for diameter of shaft selected. Take G= 80 GPa. **07**

OR

Q.3 **(a)** State assumptions made in theory of pure bending. **03**

(b) For a hollow circular section whose external diameter is twice the internal diameter, find the ratio of maximum shear stress to average shear stress. **04**

(c) What should be the value of Θ in figure 3 which will make the motion of 1000N block down the plane to impend? The coefficient of friction for all contact surfaces is 1/3. **07**

Q.4 **(a)** Define: (i) Lateral strain (ii) Poisson's ratio (iii) Modulus of rigidity. **03**

(b) In a tension test, a bar of 20 mm diameter undergoes elongation of 14 mm in a gauge length of 150 mm and a decrease in diameter of 0.85 mm at a tensile load of 6 kN. Determine the two physical constants Poisson's ratio and modulus of elasticity of the material. **04**

(c) Determine the centroid of the plane area in which a circular part of 40 mm radius, has been removed as shown in Figure 4. **07**

OR

Q.4 **(a)** Determine the surfaces area and volume of a right circular cone with radius of base R and height h using Pappus-Guldinus theorem. **03**

(b) Derive expression of moment of inertia of triangle by first principal. **04**

(c) A 6 m long steel rod having 20 mm diameter is connected to two grips and each end at a temperature of 120^0 C. Find (i) pull exerted when temperature falls to 40^0 C and ends do not yield, (ii) pull exerted when temperature falls to 40^0 C and ends yield by 1.1 mm, (iii) the shortening allowed for no stress at 40^0 C and (iv) the minimum final temperature for shortening of 1.1 mm. **07**

Take E_{steel}= 205 GPa, α_{steel} =11 X $10^{-6}/^0$C.

Q.5 **(a)** Define: (i) Coefficient of friction (ii) Angle of friction **03**

(b) A solid circular steel shaft of diameter 75 mm can resist maximum shear stress of 75 N/mm^2. If shaft is rotating at 150 rpm, calculate the power transmitted by shaft. Also calculate the angle of twist for 1.4m long shaft if G=100 GPa. **04**

(c) Draw Shear Force and Bending Moment diagram for the beam as shown in figure 5. **07**

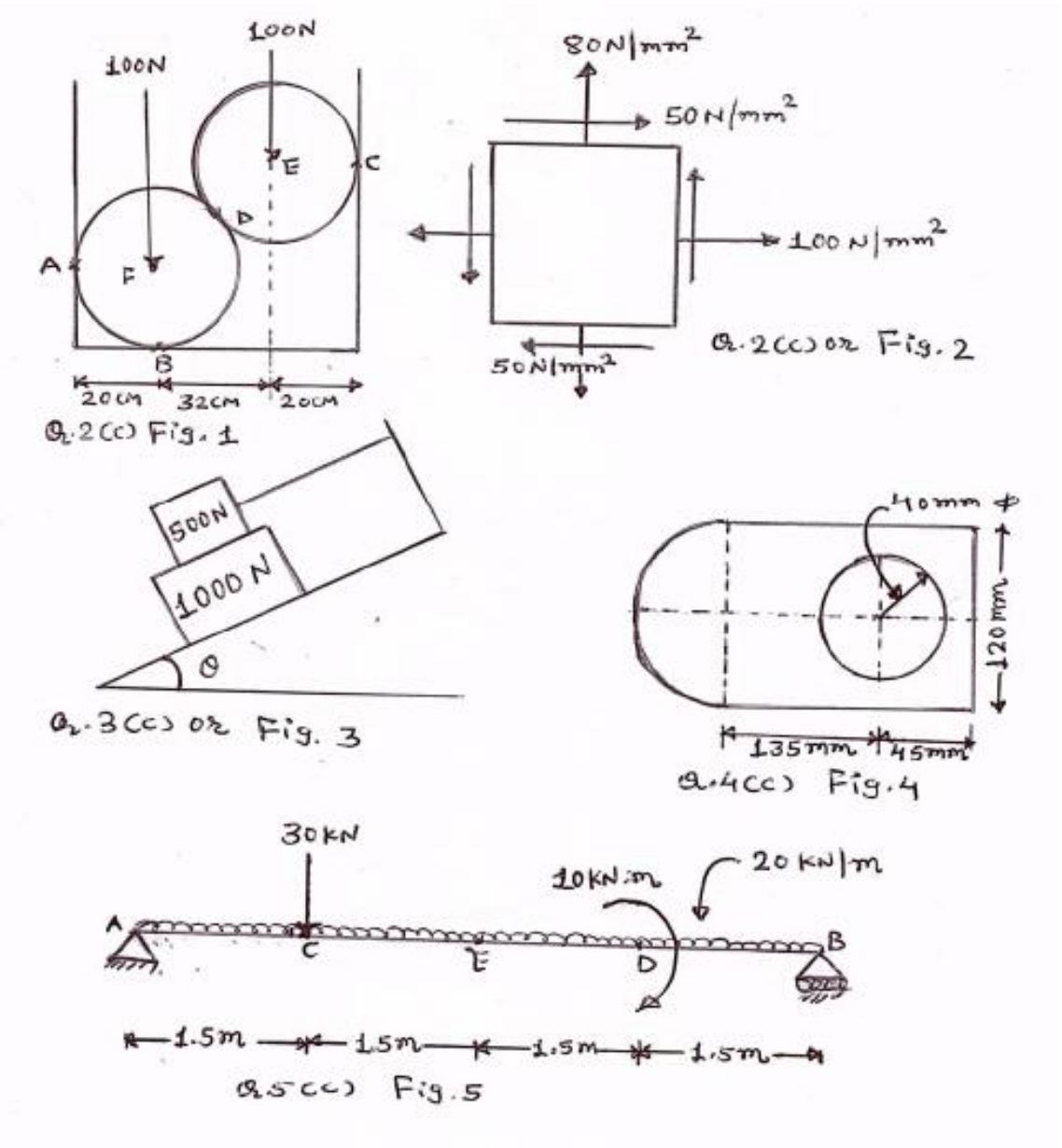
OR

Q.5 **(a)** Enlist various type of loads and type of supports. **03**

(b) A steel bar of rectangular cross section is 60 mm wide and 50 mm thickness is subjected to an axial pull of 85 kN. Calculate Normal, **04**

Tangential and Resultant stresses on an inclined plane at 30^0 to the cross section of bar.

(c) A weight 750 N just starts moving down a rough inclined plane supported by a force of 250 N acting parallel to the plane and it is at the point of moving up the plane when pulled by a force of 350N parallel to the plane. Find the inclination of the plane and the co-efficient of friction between the inclined plane and the weight. **07**



Q.2(c) Fig. 1

Q.2(c) or Fig. 2

Q.3(c) or Fig. 3

Q.4(c) Fig. 4

Q.5(c) Fig. 5

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