Seat No.:_____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER– III (New) EXAMINATION – WINTER 2019

Subject Code: 3130608 Date: 5/12/2019

Subject Name: Mechanics of Solids

Time: 02:30 PM TO 05:00 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*	(a)	Define: (1) Rigid body, (2) Newton's second Law	03
	(b)	Define Force and classify the force system with neat sketch.	04
	(c)	Find magnitude and direction of resultant of force system shown in Fig.1	07
Q.2	(a)	Define Moment & Couple giving two suitable examples	03
	(b)	State Hook's low. Draw stress strain curve for Mild Steel Specimen and explain each point in detail.	04
	(c)	A Chord supported at A,B carries a load of 20kN at point C and unknown weight W kN at D as shown in fig 2.Find the value of unknown weight W. So that CD remains horizontal.	07
		OR	
	(c)	Determine Ixx and Iyy for section shown in fig 3	07
Q.3	(a)	Define (i) Strain (ii) Poisson's ratio (iii) Bulk Modulus	03
	(b)	Find support reaction for a beam as shown in figure. 4	04
	(c)	A Reinforced concrete column is applied 700 kN load. Size of column is 300 mm X 400 mm, and it is reinforced with 6 bars of 16 mm dia. Determine load taken by concrete and steel.	07
		OR	
Q.3	(a)	Define (1) Ductile material (2) Compound bar (3) Axial load	03
	(b)	Find support reactions for a beam as shown in figure. 5	04
	(c)	A 2.8 m long member is 60 mm deep and 40 mm wide. It is subjected to axial tensile force 210 kN. Determine change in dimension and in volume. Take E=200 Gpa and $\mu = 0.3$ Assume Esteel and Econcrete	07
Q.4	(a)	Derive the formula for the elongation of a rectangular bar under the action of axial load.	03
	(b)	Explain with neat sketch types of beams, types of loads and types of supports	04
	(c)	A steel rod 25mm in diameter is inserted inside a brass tube of 25mm internal diameter and 35mm external diameter, the ends are rigidly connected together. The assembly is heated by 30^0C. Find value and nature of stress developed in both the materials. Take, $E_{steel} = 200$GPa, $E_{brass} = 80$ GPa, $\alpha_{steel} = 12 \times 10\text{-}6$ per ^{0}C, α brass $= 18 \times 10\text{-}6$ per ^{0}C.	07
		OR	
Q.4	(a)	Write the assumption made in theory of pure torsion.	03
	(b)	Derive the equation for deformation of a body due to self weight.	04
	(c)	Draw Shear Force and Bending Moment diagram for the beam shown in fig. 6	07
Q.5	(a)	Define: 1)Point of Contra flexure, 2) Shear force	03
	(b)	Derive assumption made in analysis of truss.	04
	(c)	Analysis the truss loaded as shown in figure. 7	07

OR

Q.5	(a)	\V*n te* a differ *ence* between *Truss* and frame.	03
	(b)	Explain perfect truss and imperfect truss with the sketches.	04
	(c)	Analysis the truss loaded as shown in figure 8	07

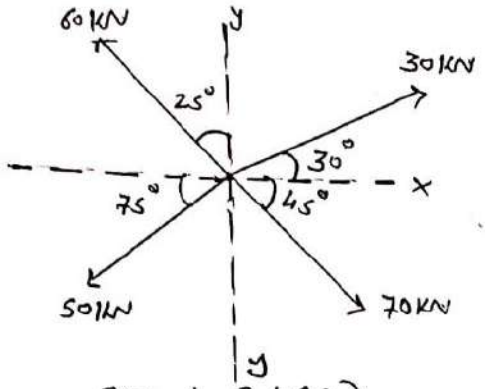

Fig. 1 Q.1 (c)

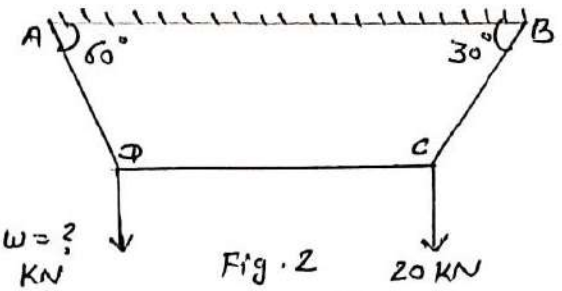

Fig. 2 Q.2 (c)

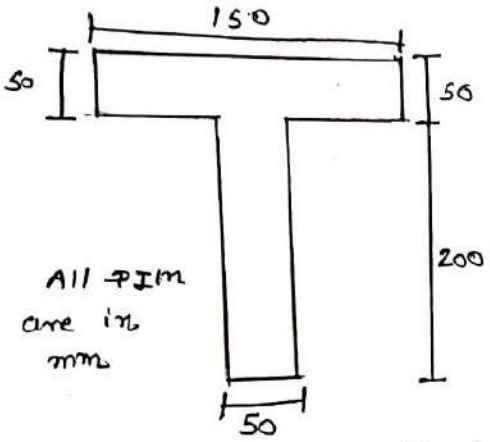

Fig. 3 Q.2 (c)

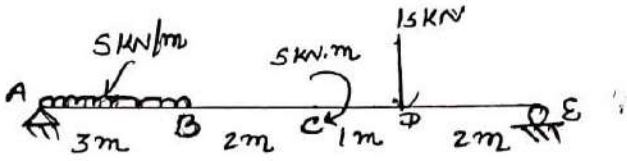

Fig. 4 Q.3 (b)

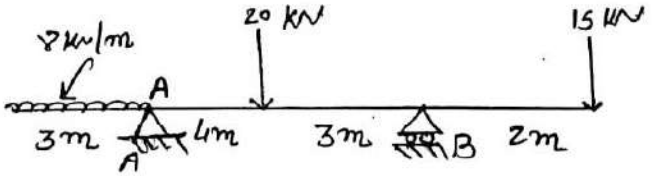

Fig. 5 Q.3 (b)

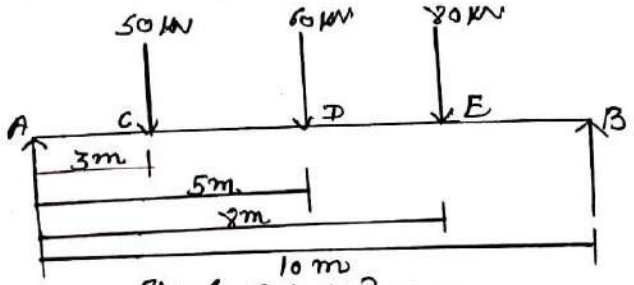

Fig. 6 Q.4 (c)

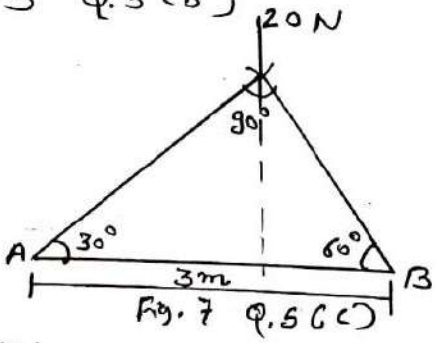

Fig. 7 Q.5 (c)

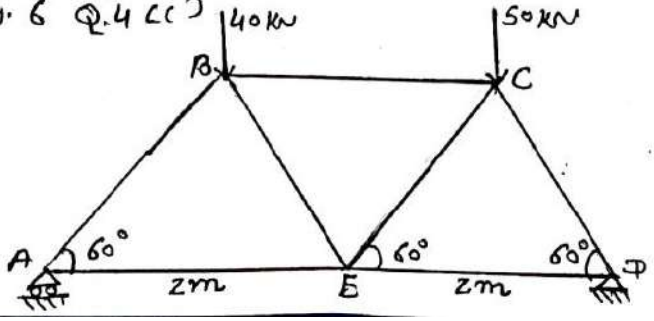

Fig. 8 Q.5 (c)

Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- SEMESTER–III (NEW) EXAMINATION – WINTER 2020

Subject Code:3130608 Date:06/03/2021

Subject Name:Mechanics of Solids

Time:10:30 AM TO 12:30 PM Total Marks:56

Instructions:

1. **Attempt any FOUR questions out of EIGHT questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1	**(a)**	Explain following terms (i) Rigid body, (ii) Deformable body (iii) Elastic body.	**03**
	(b)	State Hook's low. Draw stress strain curve for Mild Steel Specimen and explain each point in detail.	**04**
	(c)	Three forces are acting on a weightless equilateral triangular plate as shown in **Fig. 1.** Determine magnitude, direction and position of resultant force.	**07**
Q.2	**(a)**	Explain : (i) Type of beams (ii) Type of loading on the beams.	**03**
	(b)	Determine support reaction for the given beam shown in **Fig. 2.**	**04**
	(c)	A simply supported beam 10 m long carries three point loads at 100 kN, 150 kN and 200 kN at 3m, 5m and 8m from left support. Draw S.F. and B.M. diagram for the beam.	**07**
Q.3	**(a)**	Discuss critically the assumption made in theory of Bending.	**03**
	(b)	A cantilever beam 2 m long has rectangular section 200 mm x 500 mm. Find out point load at free end of beam if permissible bending stress is $20N/mm^2$.	**04**
	(c)	A beam of I-section, having 5 m length is simply supported at each end and bears a u.d.l. of 20 kN/m as shown in **Fig. 3**. Determine maximum tensile and compressive bending stress.	**07**
Q.4	**(a)**	Derive with usual notations the theorem of perpendicular axis.	**03**
	(b)	Derive relation between bulk modulus (K), Poisson's ratio (1/m), and modulus of elasticity (E).	**04**
	(c)	A beam of I-section, having 5 m length is simply supported at each end and bears a u.d.l. of 20 kN/m as shown in **Fig. 3.** Determine maximum shear stress.	**07**
Q.5	**(a)**	Define: (1) Centroid (2) Center of gravity (3) Center of mass.	**03**
	(b)	State and prove Pappu's guldinus theorem for surface area of bodies.	**04**
	(c)	Determine the location of centroid of plane lamina shown in **Fig. 4** with respect to point O.	**07**
Q.6	**(a)**	Write assumption made in the theory of torsion.	**03**
	(b)	A solid steel shaft is to transmit 120 kW power at 600 r.p.m. Find the diameter of shaft if shear stress is to be limited to $100\ N/mm^2$.	**04**
	(c)	Determine moment of inertia about base of a plane area as shown in **Fig. 4.**	**07**

Q.7 **(a)** Define : (i) Modulus of Elasticity (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) A steel rod 30 mm in diameter is inserted inside a brass tube of 30 mm internal diameter and 40 mm external diameter, the ends are rigidly connected together. The assembly is heated by 20°C. Find value and nature of stress developed in both the materials. **07**

Take, α for steel = 12×10^{-6} per °C, α for brass = 18×10^{-6} per °C.

E for steel = 200 GPa, E for brass = 80 GPa,

Q.8 **(a)** Define principal planes and principal stresses. **03**

(b) A R.C.C. column 300 mm in dia. is reinforced with 6 nos. of 16 mm diameter steel bars. If permissible stress in steel and concrete are 230 N/mm^2 and 5 N/mm^2, respectively, find the load carrying capacity of the column. **04**

(c) The state of stress in two-dimensionally stress body at a point is shown in **Fig. 5.** Determine principal stresses and maximum shear stress and its location of planes. **07**

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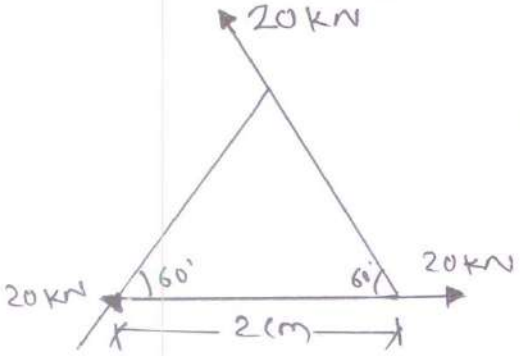

Fig-1.

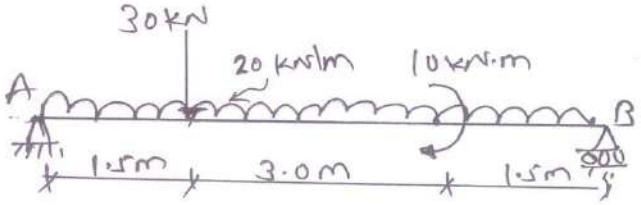

Fig-2.

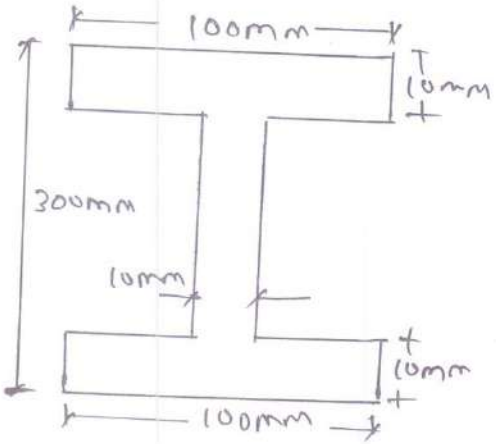

Fig-3

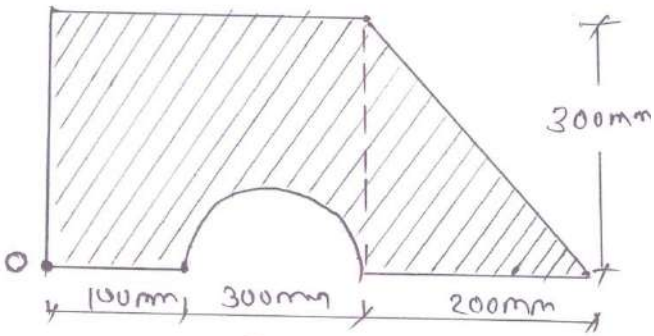

Fig-4

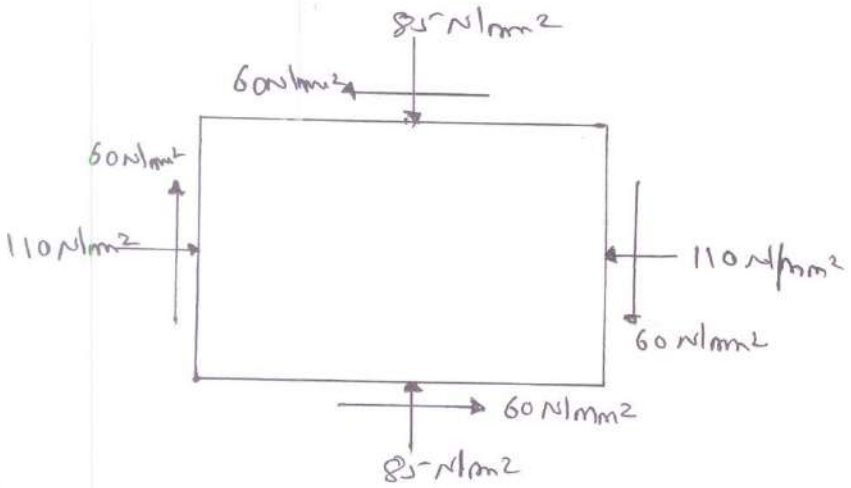

Fig.5

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Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

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

Subject Code:3130608 Date:25-02-2022

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.**

Q.1	**(a)**	State and explain Lami's theorem.	**03**
	(b)	Determine resultant of given force system shown in **Fig. 1.**	**04**
	(c)	The forces are acting on a rigid body as shown in **Fig. 2.** Find the resultant of the given force system, in terms of magnitude and direction. Find perpendicular distance of resultant force with respect to point A.	**07**
Q.2	**(a)**	Explain various types of statically determinant beams and their support system.	**03**
	(b)	Differentiate between joint method and section method in analysis of plane truss.	**04**
	(c)	Draw Shear Force and Bending Moment diagram for the beam shown in **Fig. 3.**	**07**
		OR	
	(c)	Draw Shear Force and Bending Moment diagram for the beam shown in **Fig. 4.**	**07**
Q.3	**(a)**	Draw shear stress distribution diagram for rectangular, circular and I section.	**03**
	(b)	A beam simply supported over a span of 8 m and carries an U.D.L. of 50 kN/m over whole span. The size of beam is 150 mm x 400 mm. Find the maximum bending stress and draw the bending stress diagram.	**04**
	(c)	A beam of T shaped cross section shown in **Fig. 5** is subjected to bending about x-x axis due to a moment of 20 kN.m. Find the bending stress at top and bottom of the beam.	**07**
		OR	
Q.3	**(a)**	Write assumptions made in theory of pure bending.	**03**
	(b)	Find the support reaction for beam which is loaded as shown in **Fig. 6.**	**04**
	(c)	A beam of T shaped cross section shown in **Fig. 5** is subjected to maximum shear force of 50 kN. Determine maximum shear stress.	**07**
Q.4	**(a)**	Derive with usual notations the theorem of perpendicular axis.	**03**
	(b)	Write equation of Moment of inertia for rectangular section and triangular section about its neutral axis and base of section.	**04**
	(c)	Determine the location of centroid of wire which is bent as shown in **Fig. 7.**	**07**
		OR	
Q.4	**(a)**	Write assumption made in the theory of torsion.	**03**
	(b)	External and internal diameter of 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.	**04**
	(c)	Determine moment of inertia about (I_{xx}) of a plane area as shown in **Fig. 8.**	**07**

Q.5 **(a)** Define (i) Stress (ii) Strain (iii) Modulus of elasticity. **03**

(b) An underground cable is laid in a summer at 32° C. What stress would be induced in it when temperature in winter is -3° C. The cable is unable to contract in any direction. Take, $\alpha = 12 \times 10^{-6}$ per °C, El = 200 GPa. **04**

(c) A steel rod of 100 mm in diameter is inserted inside a copper tube of 200 mm external diameter and 100 mm internal diameter. The composite section is subjected to axial tensile force of 100 kN. Length of the composite section is 0.5 m. Calculate stress in each material. Take E for steel = 2.1×10^5 MPa, E for copper = 1.3×10^5 MPa. **07**

OR

Q.5 **(a)** Define principal planes and principal stresses. **03**

(b) A steel bar 16 mm diameter and 3 m long is subjected to an axial pull of 80 kN. Determine the change in dimension and change in volume of the bar. Take E = = 2×10^5 MPa and $\mu = 0.3$. **04**

(c) The state of stress in two-dimensionally stress body at a point is shown in **Fig. 9.** Determine (i) principal stresses (ii) maximum shear stress and its location of planes. **07**

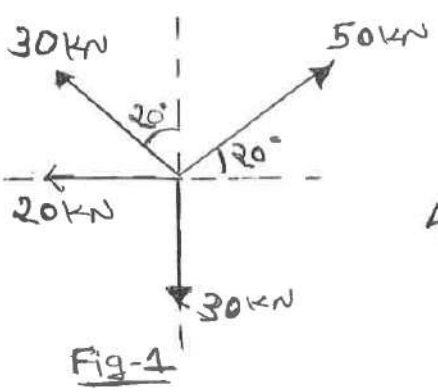

Fig-1

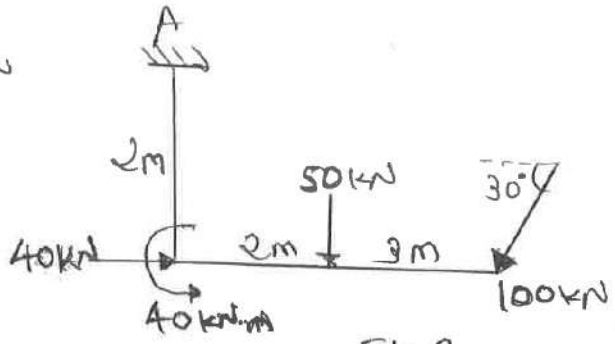

Fig-2

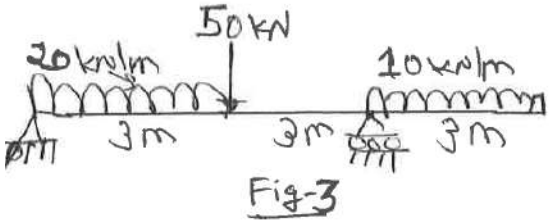

Fig-3

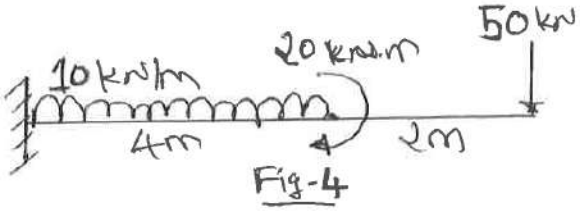

Fig-4

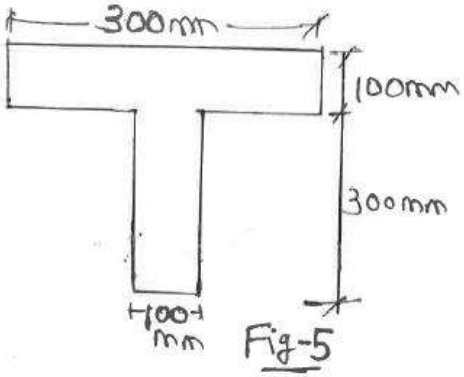

Fig-5

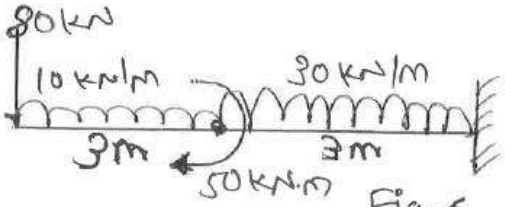

Fig-6

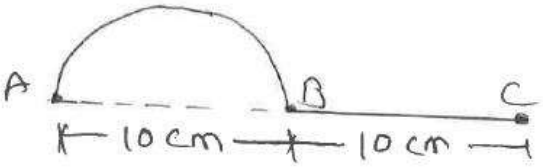

Fig-7

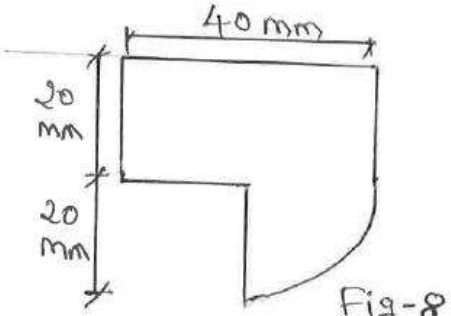

Fig-8

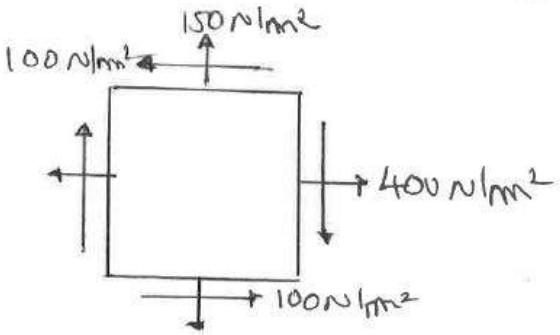

Fig. 9

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Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER– III EXAMINATION – SUMMER 2020

Subject Code: 3130608 Date:04/11/2020

Subject Name: Mechanics of Solids

Time: 02:30 PM TO 05:00 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	**(a)**	State's Law of Parallelogram of forces.	**03**
	(b)	Define force and writes its characteristics.	**04**
	(c)	Find the magnitude and direction of resultant of force system shown in fig. 01.	**07**
Q.2	**(a)**	What is meant by free body diagram? Draw free body diagram for box place on a table.	**03**
	(b)	Define : (1) Isotropic material (2) Anisotropic material (3) Homogeneous material (4) Orthotropic material.	**04**
	(c)	Find the minimum (least) value of force P to keep the sphere in the position shown in fig. 02. The radius of sphere 1 is 5cm and sphere 2 is 10cm. The weight of sphere 1 is 100N and sphere 2 is 200N.	**07**
		OR	
	(c)	Draw shear force diagram and bending moment diagram for a beam shown in fig. 03.	**07**
Q.3	**(a)**	What is difference between deficient truss and redundant truss.	**03**
	(b)	Explain types of supports with usual notations.	**04**
	(c)	Find the CG of plane lamina shown in fig 4.	**07**
		OR	
Q.3	**(a)**	Explain : (1) Poisson's ratio (2) Hook's law (3) Bulk modulus.	**03**
	(b)	A bar of 3m long and 20mm diameter is rigidly fixed in two supports at certain temperature. If temperature is raised by 60° C, find the thermal stress and strain of the bar. Also find thermal stress and strain if support yields by 2 mm. Take $\alpha = 12 \times 10^{-6}$ / °C and $E = 2 \times 10^5$ N/mm^2.	**04**
	(c)	State and explain with figure Pappu's –Guildinus theorem of surface area of Revolution.	**07**
Q.4	**(a)**	Enlist the assumptions made in theory of torsion.	**03**
	(b)	A beam simple supported and carries an U.D.L. of 50 kN/m over whole span. The size of beam is 150mm x 400mm.. If maximum stress in the material of beam is 100N/mm^2 find the span of beam.	**04**
	(c)	Determine the centroid of the section shown in fig. 05.	**07**

OR

Q.4	**(a)**	A load of 10 kN is to be raised with help of a steel wire. Find the minimum diameter of the wire, if the stress is not to be exceed 80 N/mm^2.	**03**
	(b)	Explain types of beams with notations.	**04**
	(c)	Determine moments of inertia of a section shown in fig. 06 about horizontal centroidal axis.	**07**
Q.5	**(a)**	Define: (1) Shear Force (2) Bending Moment (3) Points of contraflexure	**03**
	(b)	Derive the relation between : (1) Young's Modulus (2) Modulus of Rigidity (3) Possion's Ratio	**04**
	(c)	A hollow steel shaft, 3m of length must transmit a torque of 25 kNm. The total angle of twist in this length is not to exceed 2.5° and the allowable shearing stress in the material is 90 MPa. Calculate the inside diameter of the shaft and thickness of the metal. G = 85 GN/m^2.	**07**

OR

Q.5	**(a)**	Draw shear stress distribution diagram for : (1) I section (2) Circular section (3) Triangular section	**03**
	(b)	Explain assumptions made in theory of pure bending.	**04**
	(c)	A square prism of metal 60mm x 60mm in cross section and 300mm long is subjected to a tensile stress of 450 MPa along its longitudinal axis, lateral compression of 240 MPa and lateral tension of 120 MPa along the pair of sides. If E = 150 GPa, calculate the changes in dimensions, change in volume of metal. $\mu = 0.36$.	**07**

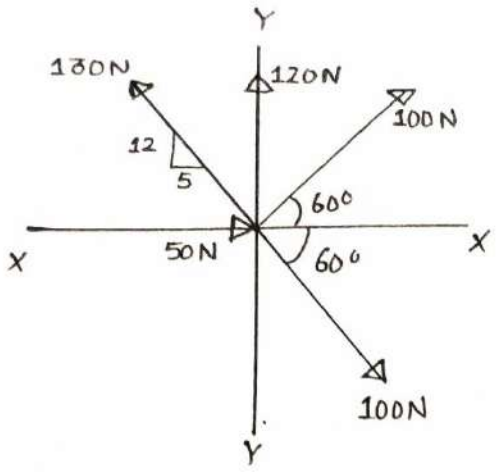

Fig. 01

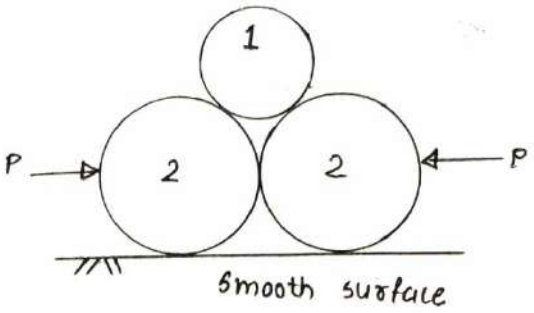

Fig. 02

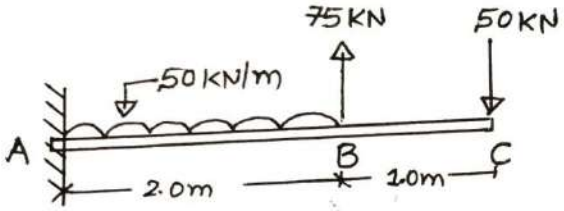

Fig. 03

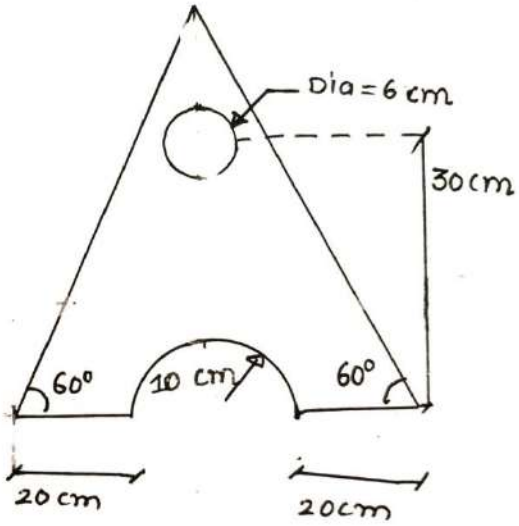

Fig. 04

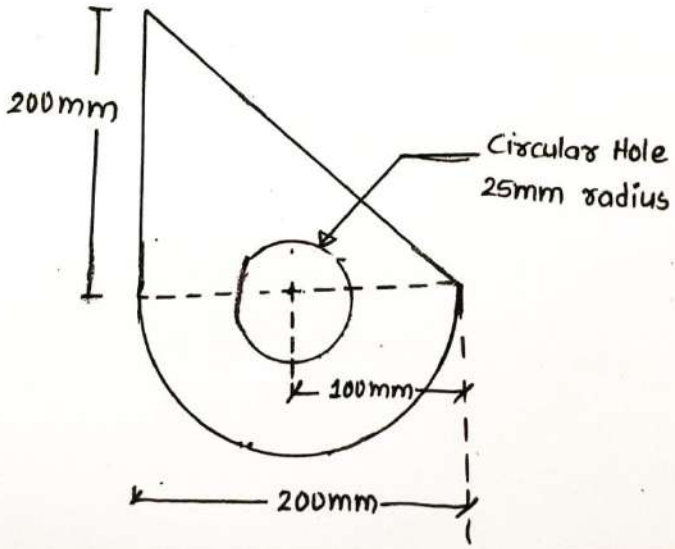

Fig. 05

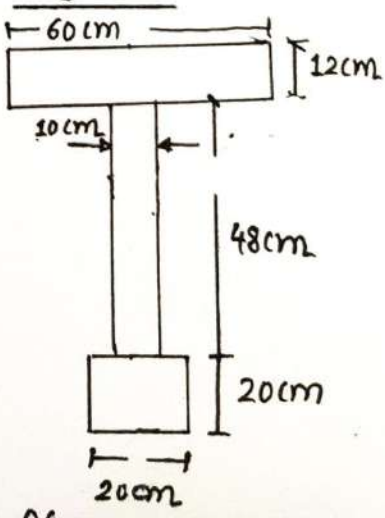

Fig. 06

Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

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

Subject Code:3130608 Date:16/09/2021

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.**

			MARKS
Q.1	**(a)**	State the characteristics of couple.	**03**
	(b)	State and explain parallelogram law of forces.	**04**
	(c)	Calculate magnitude and direction of the resultant force of the force system shown in **Figure-1**. Each square is of size 10 cm × 10 cm as shown in Figure-1.	**07**

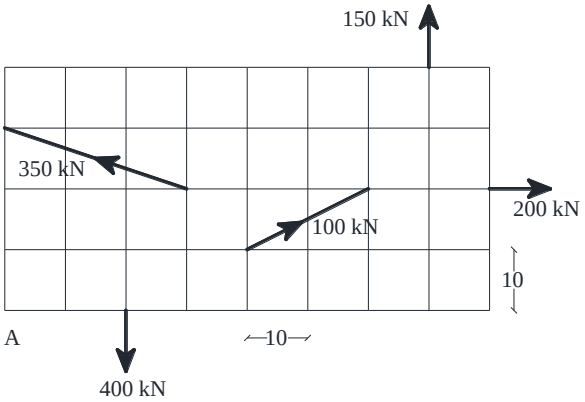

Figure-1

Q.2	**(a)**	State and explain Lami's theorem.	**03**
	(b)	Calculate the point of application of resultant force of the force system shown in **Figure-1**. Each square is of size 10 cm × 10 cm as shown in Figure-1.	**04**
	(c)	Determine the support reactions for the beam shown in **Figure-2**. Also plot the shear force and bending moment diagrams.	**07**

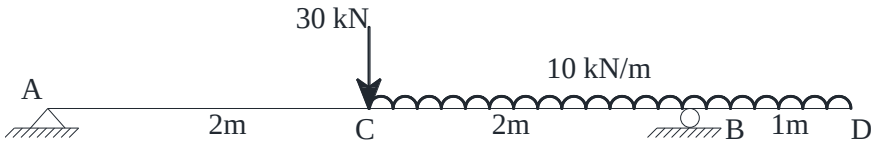

Figure-2

OR

	(c)	Determine the support reactions for the beam shown in **Figure-3**. Also plot the shear force and bending moment diagrams.	**07**

Figure-3

Q.3	**(a)**	Mention the assumption made in the theory of pure bending.	**03**

(b) Derive using first principle the equation for calculation of maximum shear stress at a section for a beam with rectangular cross section. **04**

(c) Calculate the maximum bending stress and maximum shear stress at a section for the beam shown in **Figure-3**. Beam cross section is 300mm × 500mm deep. **07**

OR

Q.3 **(a)** Write the assumptions made in the analysis of perfect truss. **03**

(b) State and explain Verignon's principle. **04**

(c) Calculate the maximum bending stress and maximum shear stress at a section for the beam shown in **Figure-2**. Beam cross section is 300mm wide × 500mm deep. **07**

Q.4 **(a)** State parallel axes and perpendicular axes theorems. **03**

(b) Derive torsion equation with usual notations. **04**

(c) Locate the centroid from the given reference axes of the lamina shown in **Figure-4**. **07**

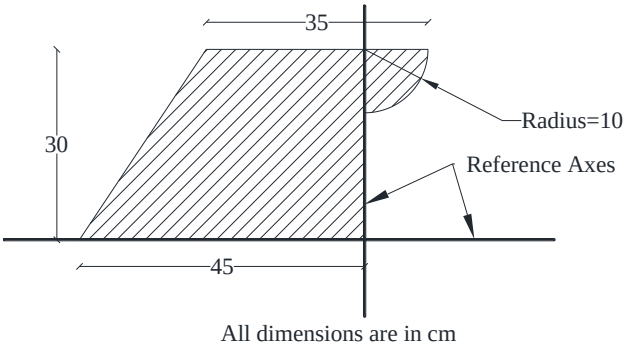

Figure-4

OR

Q.4 **(a)** State assumptions made in theory of torsion. **03**

(b) Derive the equation to locate centroid of the semicircular lamina. **04**

(c) Calculate the moment of inertia of the section about the horizontal axis passing through the base. Refer **Figure-4**. **07**

Q.5 **(a)** State and explain Hook's law. **03**

(b) A brass rod ABCD having a c/s area of 500mm^2 is subjected to axial forces as shown in **Figure-5**. If modulus of elasticity for brass is 80kN/mm^{2,} find the change in the length of the bar. **04**

Figure-5

(c) The tensile stresses at a point across two mutually perpendicular planes are 120N/mm^2 and 60N/mm^2. Determine the normal, tangential and resultant stresses on a plane inclined at 30° to the axis of the minor stress. **07**

OR

Q.5 **(a)** Describe the Mohr's circle method to calculate principal stresses. **03**

(b) A brass rod ABCD having a c/s area of 500mm^2 is subjected to axial forces as shown in **Figure-5**. If modulus of elasticity for brass is 80kN/mm^{2,} find stress in each part of the bar. **04**

(c) A rectangular block of material is subjected to tensile stresses of 110MPa and 50MPa. Each of these stresses is accomplished by shear stress of 60MPa which tends to rotate block in anticlockwise direction. Determine direction and magnitude of Major and Minor principal stress on oblique plane. **07**

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Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER– III (NEW) EXAMINATION – SUMMER 2022

Subject Code:3130608 Date:20-07-2022

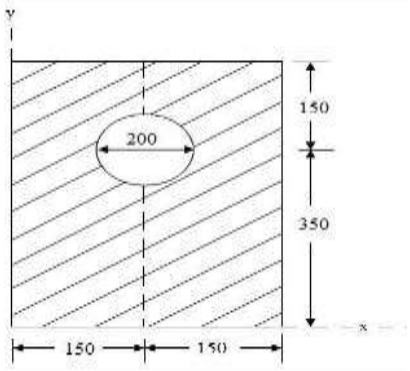
Subject Name:Mechanics of Solids

Time:02:30 PM TO 05:00 PM Total Marks:70

Instructions:

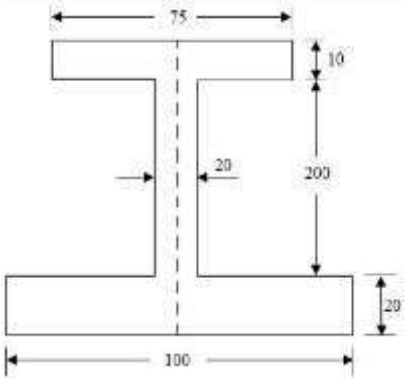
1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Simple and non-programmable scientific calculators are allowed.**

			Marks
Q.1	**(a)**	Define: (1) Rigid Body (2) Newton's second law (3) Law of Transmissibility.	**03**
	(b)	State and explain parallelogram law of forces.	**04**
	(c)	The following forces act at a point: (1) 20 N inclined at 30° towards North of East, (2) 25 N towards North, (3) 30 N towards North West, (4) 35 N inclined at 40° towards South of West. Find magnitude and direction of the resultant force.	**07**
Q.2	**(a)**	Differentiate between Moment and Couple.	**03**
	(b)	State and explain Lami's theorem.	**04**
	(c)	Find the moment of inertia of a plate with a circular hole about its centroidal x axis as shown in figure below.	**07**



OR

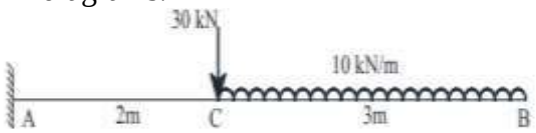
	(c)	Find the position of the centroid of I-section as shown in Figure.	**07**



Q.3 **(a)** Explain: (1) Types of beams (2) Types of reactions. **03**

(b) State Hook's law. Draw stress strain curve for MS specimen and explain each point in detail. **04**

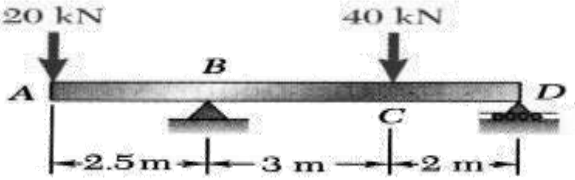
(c) Determine the support reactions for the beam shown below. Also plot SF and BM diagrams. **07**



OR

Q.3 **(a)** Define stress. Also explain types of stresses. **03**

(b) Determine support reaction for the given beam shown in figure below. **04**



(c) For above figure draw SF and BM diagram with calculation. **07**

Q.4 **(a)** Discuss critically the assumption made in theory of Pure Bending. **03**

(b) State and explain Verignon's principle. **04**

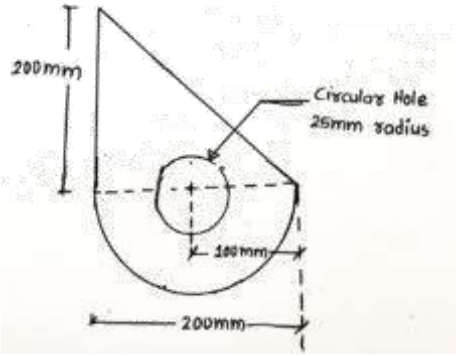
(c) A reinforced concrete column is applied 700 kN load. Size of column is 250mm X 450mm, and it is reinforced with 6 bars of 20mm dia. Determine load taken by column and steel. **07**

OR

Q.4 **(a)** What is difference between deficient truss and Redundant truss. **03**

(b) Derive the formula for the elongation of a rectangular bar under the action of axial load. **04**

(c) Determine the centroid of the section shown in Figure below. **07**



Q.5 **(a)** State parallel axes and perpendicular axes theorems. **03**

(b) Derive torsion equation with usual notations. **04**

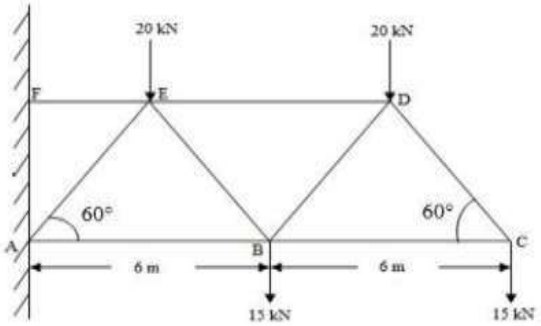
(c) Draw the mohr's stress circle for direct stresses of 70 MN/m^2 (tensile) and 40 MN/m^2 (compressive) and estimate the magnitude and direction of the resultant stresses and planes making angles of 30° and 70° with the plane of the first principal stress. Find also the normal and tangential stresses on these planes. **07**

OR

Q.5 **(a)** Describe the Mohr's circle method to calculate principal stresses. **03**

(b) Derive assumption made in analysis of truss. **04**

(c) Determine the forces in the members DE, BE and AB of the truss, shown in figure below. **07**



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