Reg. No._____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

THIRD SEMESTER B.TECH DEGREE EXAMINATION, JANUARY 2017

Course Code**: CE201**

Course Name**: MECHANICS OF SOLIDS (CE)**

Max. Marks: 100 Duration: 3 Hours

PART A

(Answer any two questions)

1. (a) Draw and explain the stress strain diagram for mild steel (7.5)
   (b) Derive the expression for elongation of a tapering circular section subjected to axial load (7.5)
2. Derive all the relations between elastic constants (15)
3. (a) A copper rod 25 mm in diameter is encased in a steel tube 30 mm internal diameter and 35 mm external diameter. The ends are rigidly attached. The composite bar is 500 mm long and is subjected to an axial pull of 30 kN. Find the stresses induced in the rod and the tube. Take E for steel as 2×10^5 N/mm^2 and E for copper as 1×10^5 N/mm^2. (10)

   (b) The rails of a railway line is laid so that there is no stress in the rails at 10 ^{o}C. Calculate the stress in the rails at 60 ^{o}C if there is an expansion allowance of 10 mm per rail. (5)

PART B

(Answer any two questions)

4. (a) Draw the BMD and SFD for a cantilever beam subjected to central concentrated load. (7.5)

   (b) Draw the BMD and SFD for a simply supported beam with udl over entire span. (7.5)

5. (a) A rectangular timber joist of 6 m span has to carry a load of 15 kN/m. Find the dimensions of the joist if the maximum permissible stress is limited to 8 N/mm^2. The depth of the joist has to be twice the width. (7.5)

(b) A 300 mm x 160 mm rolled steel joist of I section has flanges 11 mm thick and web 8 mm thick. Find the safe uniformly distributed load that the section will carry over a span of 5 m if the permissible stress is limited to 120 N/mm^2. (7.5)

6. Derive the expression for shearing stress in a beam section stating the assumptions made (15)

PART C

(Answer any two questions)

7. (a) Explain principal planes and principal stresses (5)
   (b) A point is subjected to a tensile stress of 60 N/mm^2 and a compressive stress of 40 N/mm^2, acting on two mutually perpendicular planes. A shear stress of 10 N/mm^2 is also acting on these planes. Determine the principal stresses and the maximum shear stress. (15)
8. Select a suitable diameter of a solid shaft of circular section to transmit 112.5 kW of power at 200 r.p.m., if the allowable shear stress is 75 N/mm^2 and the allowable twist is 1^o in a length of 3 m. Take G as 0.82 x 10^5 N/mm^2. (20)
9. (a) What are the assumptions in Euler's column theory. (5)

   (b) Write the equations for Euler's crippling load for columns with both ends hinged, both ends fixed, one end fixed and the other hinged, one end fixed and the other free. (5)

   (c) A hollow alloy tube 5 m long with diameters 40 mm and 25 mm was found to extent 6.4 mm under a tensile load of 60 kN. Find the buckling load for the tube when used as a strut with both ends pinned. (10)

Reg. No._____ Name:_____

A P J ABUL KALAM TECHNOLOGICAL UNIVERSITY

THIRD SEMESTER B.TECH DEGREE EXAMINATION, JULY 2017

CE 201: MECHANICS OF SOLIDS (CE)

Max. Marks:100 Duration: 3 Hours

PART A

Answer any 2 complete questions each having 15 marks

1. (a) In an experiment, a bar of 30 mm diameter is subjected to a pull of 60 kN. The measured extension on a guage length of 200 mm is 0.09 mm and the change in diameter is 0.0039 mm. Calculate the Poisson's ratio and the value of the three moduli. (10)

   (b) Define the terms stress and strain. What ate the different types of stresses and strains? (5)

2. (a) A compound bar consists of a circular rod of steel of diameter 20 mm rigidly fitted into a copper tube of internal diameter 20 mm and thickness 5 mm. If the bar is subjected to a load of 100 kN , find the stresses developed in the two materials. Take Es = $2x10^5$ N/mm^2 and Ec =$1.2x10^5$ N/mm^2 (10)

   (b) What is strain energy? Give the expression for strain energy due to axial force. (5)

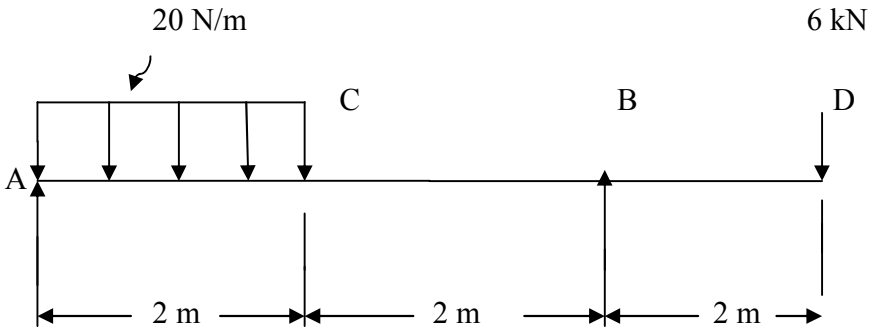
3. (a) A railway line is laid so that there is no stress in the rails at 8^0C. Calculate (a) the stress on the rails at 50^0C if there is no allowance for expansion. (b) the stress in the rails if there is an expansion allowance of 8 mm. (c) the expansion allowance if the stress in the rails is to be zero . (d) the maximum temperature to have no stress in the rails if the expansion allowance is 12 mm. The rails are 30 mm long. Take $\alpha = 12 \times 10^{-6}$ per ^{0}C and $E = 2 \times 10^5$ N/mm^2 (10)

   (b)Derive the expression for deformation of a bar of constant section due to self weight. (5)

PART B

Answer any 2 complete questions each having 15 marks

4. (a) Draw the shear force and bending moment diagram for the beam given.



(10)

(b) Derive the relation between intensity of loading, shear force and bending moment. (5)

5. (a) A simply supported beam AB of 4 m span carries a uniform load of 30 kN/m over the right hand half of the span. Draw SFD and BMD. (10)
   (b) Distinguish between bending moment and moment of resistance (5)
6. (a) A cast iron beam has an I-section with top flange 80 mm x 40 mm, web 120 mm x 20 mm and bottom flange 160 mm x 40 mm. If tensile stress is not to exceed 30 N/mm^2 and compressive stress 90 N/mm^2, what is the maximum UDL the beam can carry over a simply supported span of 6 m if the larger flange is in tension? (10)
   (b) Sketch the bending stress as well as shear stress distribution diagram for a beam of rectangular cross section. (5)

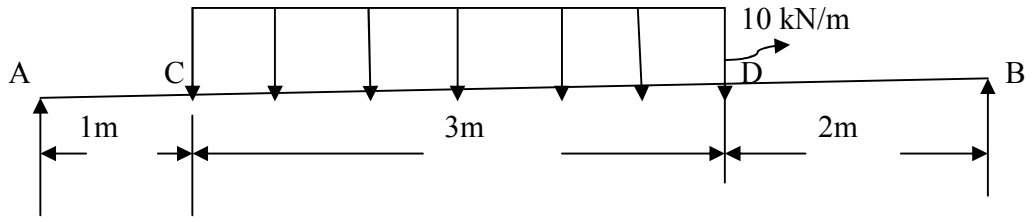
PART C

Answer any 2 complete questions each having 20 marks

7. (a) At a point in a material stress components are p_x = 500 MPa (tensile), p_y = 10 MPa (tensile) and q = 20 MPa. Determine (i) the planes on which shear stress is maximum, (ii) principal planes and (iii) stress components on these planes. (12)
   (b) Derive the torsion equation for a solid circular shaft. (8)

8. (a) A beam AB is 6m long and has a moment of inertia of 450×10^6 mm^4. It is supported at A and B and carries a UDL of 10 kN/m as shown in figure. Calculate (i) Slope at A and (ii) maximum deflection.

   Take E = 200 kN/mm$^{2.}$



(15)

(b) State and explain moment area theorems. (5)

9. (a) A hollow metallic tube of 60 mm external diameter, 50 mm internal diameter and 8 m long is fixed at one end and its upper end is free. Calculate the maximum load that it can withstand. Crushing strength of the material = 300 MPa, Rankine's constant = 1/7500.

(12)

(b) What are the assumptions made in Euler's column theory? (8)

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Total Pages: 2

Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

THIRD SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2017

Course Code: CE201

Course Name: MECHANICS OF SOLIDS (CE)

Max. Marks: 100 Duration: 3 Hours

PART A

Answer any two full questions, each carries 15 marks.

			Marks
1	a)	Define stress and strain.	(4)
	b)	What are the fundamental types of stresses? Give one example for each type.	(4)
	c)	State and explain Hooke's Law.	(7)
2	a)	Prove that the maximum value Poisson's ratio can have is 0.5	(5)
	b)	A cylindrical bar with two sections of lengths 50cm and 25cm, and diameters 20mm and 15mm respectively, is subjected to an axial pull such that the maximum stress is 150MN/m^2. Calculate the strain energy stored in bar. E= 200 GN/m^2.	(10)
3	a)	Find an expression for the elongation of a prismatic bar due to self-weight.	(5)
	b)	A mild steel rod 20mm diameter and 300mm long is enclosed centrally inside a hollow copper tube of external diameter 30mm and internal diameter 25mm. The ends of the tube and rod are brazed together, and the composite bar is subjected to an axial pull of 50N. If E for steel and copper are 200 GN/m^2 and 100 GN/m^2 respectively, find the stresses developed in the rod and the tube. Also, find the change in length.	(10)

PART B

Answer any two full questions, each carries 15 marks.

4	a)	Name and explain the various types of beam supports, indicating the reaction components diagrammatically.	(4)
	b)	Derive a relationship between bending moment and shear force.	(5)
	c)	Draw the shear force and bending moment diagrams for a cantilever of span 3m, with a UDL of 10kN/m on the entire span, and a point load of 100kN at the free end.	(6)
5	a)	Draw the shear force and bending moment diagrams for a simply supported beam of span 4m, with a UDL of 10kN/m on the left half of its span.	(7)

b) A cantilever beam with span 3m and cross section 200×300mm is to carry a UDL on the entire span. If the tensile stress is limited to 3MPa, what is the maximum UDL that can be applied on the beam? (8)

6 a) Derive the classic bending equation. (9)

b) A simply supported rectangular wooden beam of span 2.5m has cross section 150mm×250mm and carries a central point load of 100N. Find the shear stressat 50mm below the top edge of the middle cross section. (6)

PART C

Answer any two full questions, each carries 20 marks.

7 a) Draw Mohr's circlefor the two-dimensional state of stress shown in Fig. 2. Find the principal stresses and their planes. (14)

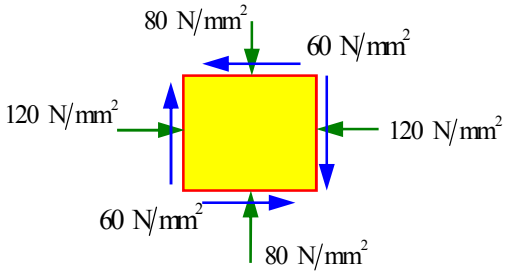

Fig. 2

b) A solid circular shaft is to transmit 75 kW power at 200 rpm. If the shear stress is not to exceed 50 MPa, find the diameter of shaft. G = 100 GPa. (6)

8 a) A 2m long thin cylindrical shell (both ends closed), internal diameter 90cm and thickness 12mm, is subjected to internal pressure 2N/mm^2. Find 1) hoop and longitudinal stresses, 2) changes in diameter and length shell. Take E = 2×10^5 N/mm^2 and Poisson's ratio = 0.3. (10)

b) Derive an expression for Euler's buckling load for a column fixed at both ends. (10)

9 a) Using moment-area method, find the deflection and slope at the free end of a cantilever applied with a couple at the free end. (10)

b) Find the buckling load given by Rankine's formula for a tubular strut hinged at both ends, 6 m long having outer diameter 15 cm and thickness 2 cm. Given, E = 2×10^{5}N/mm^2, σ_c= 567N/mm^2 and Rankine's constant, a= 1/1600. For what length of the column does the Euler's formula cease to apply? (10)

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Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

THIRD SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2018

Course Code: CE201

Course Name: MECHANICS OF SOLIDS

Max. Marks: 100 Duration: 3 Hours

PART A

Answer any two full questions, each carries 15 marks. Marks

1 a) Define the following terms: (i) Modulus of Rigidity (ii) Proof Resilience (iii) Factor of safety. (3)

b) The maximum instantaneous extension, produced by an unknown falling weight through a height of 4 cm in a vertical bar of length 3 m and of cross sectional area 5 cm^2, is 2.1 mm. Determine (a) the instantaneous stress induced in the vertical bar, and(b)the value of unknown weight. Take $E=2\times10^5$ N/mm^2 (8)

c) Derive the relation between Modulus of elasticity and Bulk Modulus. (4)

2 a) Write down the expression for elongation of tapering bars of (i) circular cross section (ii) rectangular cross section (4)

b) A steel rod of 3 cm diameter and 5 m length is connected to two grips and the rod is maintained at a temperature of 95^oC. Determine the stresses and pull exerted when the temperature falls to 30^oC if (i) the ends do not yield and (ii) the ends yield by 0.12 cm. Take $E = 2\times10^5$ N/mm^2 and $\alpha = 12\times10^{-6}$ /^{o} C. (7)

c) A cylindrical bar with two sections of lengths 50cm and 25cm, and diameters 20mm and 15mm respectively is subjected to an axial pull such that the maximum stress is 150MN/m^2. Calculate the strain energy stored in the bar. $E=200GN/m^2$ (4)

3 a) When a copper wire of length 2 m and diameter 40 mm is subjected to an axial pull of 80 kN, its diameter reduces by 0.00775 mm. The modulus of elasticity of copper is 105 GPa, calculate the extension of the wire, Poisson's ratio and modulus of rigidity of the material. (6)

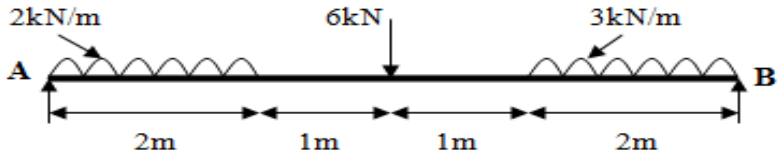
b) A compound tube consists of a steel tube 140 mm internal diameter and 160mm external diameter and an outer brass tube 160 mm internal diameter and 180 mm external diameter. The length of the compound tube is 150 mm and it carries an axial load of 900 kN. Find the stresses and load carried by each tube and the amount it shortens. Take E steel = 2×10^5 N/mm^2 and E brass = 1.1×10^5 N/mm^2. (9)

PART B

Answer any two full questions, each carries 15 marks.

4 a) A cantilever beam of span L, fixed at the left end, carries a clockwise moment M at its centre and a point load at the free end. Draw the SFD and BMD (5)

b) Draw the shear force and bending moment diagram of the simply supported beam AB shown below. Mark the salient values. Also find maximum bending moment. (10)



5 a) Define point of contra flexure and section modulus. (5)

b) A beam ABCD 12 m long carries a uniformly distributed load of 25kN/m. It is simply supported at A and C 10 m apart with an overhang CD of 2m. It also carries a clockwise couple of 100 kNm at B, 3 m from A. State the position and amount of maximum BM. Sketch the SFD and BMD (10)

6 a) What are beams of uniform strength? (5)

b) A cast iron beam of triangular section of 100 mm width and 100 mm depth is placed with its base horizontal. The beam is simply supported over a span of 6 m. If the allowable stress in tension and compression are 50 MPa and 150 MPa respectively, find the safe concentrated load at the centre of the beam. What are the extreme fibre stresses? (10)

PART C

Answer any two full questions, each carries 20 marks.

7 a) Derive the expression for normal stress on a plane inclined at an angle θ to x axis and subjected to normal stresses in X and Y directions. (6)

b) Show that in thin cylinders, the circumferential stress is twice the longitudinal stress when subjected to internal pressure. (6)

c) Determine the maximum power transmitted at 280 rpm by a steel shaft of 35 mm internal diameter and 4.5 mm thick, if the allowable stress is 75 MPa and the angle of twist is not to exceed 1˚ in a length of 1.5 m. Assume G= 80 GPa for the material. (8)

8 a) At a point in a stressed material, the normal stress on a plane is 50 N/mm^2 (T) and a normal stress of 30 N/mm^2 (C) is acting on the plane perpendicular to the given plane. The shear stress acting on these planes is 25 N/mm^2. Determine the principal stresses and their planes using Mohr's circle. Also determine the maximum shear stress at that point. (10)

b) Differentiate Macaulay's method, double integration method and moment area method in computation of slope and deflection in beams (4)

c) A steel column made of a 4 m long hollow circular section, having 300 mm internal diameter and 20 mm thick, is fixed at both the ends. Determine the safe axial load the column can carry with a factor of safety 3.5 using Euler's formula. $E=2.1\times10^5$ N/mm^2 (6)

9 a) Define i) slenderness ratio ii) Kern of a circular section (5)

b) State the various stresses acting at a point in a thick cylinder with closed ends subjected to internal pressure. Write down the Lame's equations detailing the various terms. (5)

c) Find the maximum deflection and slope at the supports of a simply supported beam of span 6 m and carrying a udl of 2 kN/m over the left half of the span. Assume $EI = 4 \times 10^{12}$ Nmm^2 (10)

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Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

THIRD SEMESTER B.TECH DEGREE EXAMINATION(S), May 2019

Course Code: CE201

Course Name: MECHANICS OF SOLIDS

Max. Marks: 100 Duration: 3 Hours

PART A

Answer any two full questions, each carries 15 marks. Marks

1 a) Define Bulk modulus. Calculate the change in volume of a cubical block of side 120 mm subjected to a hydrostatic pressure of 70 MPa. Take Poisson's ratio 0.28 and young's modulus 200 GPa. (5)

b) A steel rod 2 m long and 3 mm in diameter is extended by 0.75 mm when a weight W is suspended from the wire. If the same weight is suspended from a brass wire, 2.5 m long and 2 mm in diameter, it is elongated by 4.64 mm. Determine the modulus of elasticity of brass if that of steel be 2×10^5 N/mm^2. (10)

2 a) State and explain principle of superposition. (5)

b) Calculate the total deformation of the bar shown in fig.1 What will be the diameter of a bar of uniform cross section, to have the same strain as that of the stepped bar? Take Young's modulus as 200 GPa. (10)

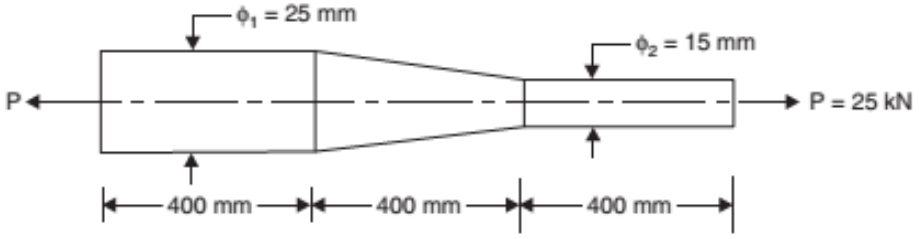

Fig.1

3 a) The composite bar shown in fig.2 is rigidly fixed at the ends A and B. Determine the reaction developed at ends when the temperature is raised by 25^0c. Given E_{cu} =140 kN/mm^2 , E_s =200 kN/mm^2, α_{cu} = $17.5\times10^{-6}/^0C$, α_s = $12\times10^{-6}/^0C$ (10)

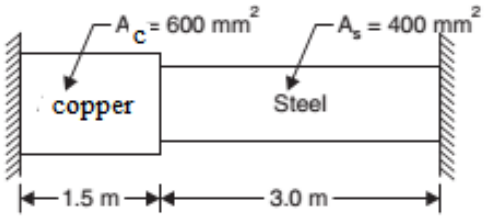

Fig.2

b) Define the terms i) Resilience ii) Proof resilience iii) Modulus of resilience (5)

PART B

Answer any two full questions, each carries 15 marks.

4 a) Explain the following: (5)

i) Shear force and bending moment in a beam.

ii) Hogging and sagging moments.

iii) Point of contra flexure.

b) Determine the load P such that reactions at supports A and B are equal in the beam shown in fig3.Draw the shear force and bending moment diagrams and mark the values at salient points. (10)

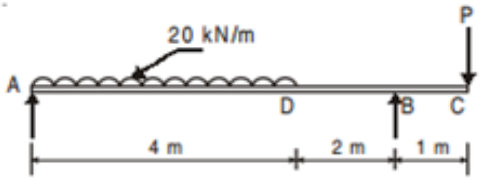

Fig.3

5 a) What is meant by pure bending? Sketch an example of a beam subjected to pure bending. (3)

b) A simply supported beam of length 3 m carries a point load of 12 kN at a distance of 2 m from left support. The cross section of the beam is as shown in Fig.4 b. (12)

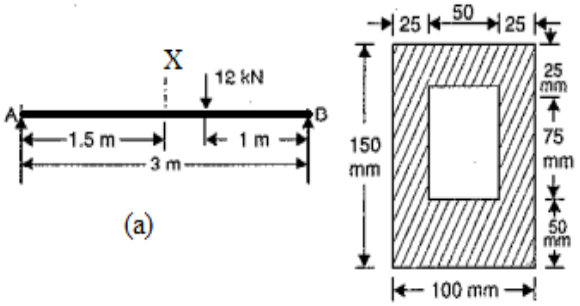

Fig.4

Determine the bending stresses at extreme fibres at section X-X. Take moment of inertia about neutral axis of the section as 2.56×10^7 mm^4.

6 a) Calculate the strain energy stored in a cantilever beam of length 2 m subjected to a point load 10 kN at the free end. Take E = 200 GPa and I= $1.5\times10^7 mm^4$. (5)

b) Calculate the moment of resistance of a composite beam made of wood and steel. The cross section is rectangular,with wood 150 mm wide and 300 mm deep, strengthened by fixing steel plates of 12 mm thickness and 300 mm deepth on either side.If the maximum stress in wood is 8 N/mm^2, what is the corresponding maximum stress attained in steel?.Take E_w=10 GPa and E_s=200 GPa. (10)

PART C

Answer any two full questions, each carries20 marks.

7 a) At a point in a strained material a direct tensile stress of 70 N/mm^2 and a direct compressive stress of 50 N/mm^2 are acting on planes at right angles to each other. If the maximum principal stress is limited to 75 N/mm^2 tensile, determine the shear stress that may be allowed on these planes. Also determine the i) minimum principal stress ii) maximum shear stress and iii) direction of principal planes. (12)

b) A solid shaft of 200 mm diameter has the same cross sectional area as that of a hollow shaft of the same material with inside diameter of 150 mm. Find the ratio of the power transmitted by the two shafts at the same speed. (8)

8 a) A thin cylinder of internal diameter 2 m contains a fluid at an internal pressure of 3 N/mm^2. Determine the maximum thickness of the cylinder if i) the longitudinal stress is not to exceed 30 N/mm^2 and ii) the hoop stress is not to exceed 40 N/mm^2. (6)

b) Write down Mohr's theorems for slope and deflection of beams. (4)

c) A cantilever beam is 2 m long and has a flexural rigidity of 25MN-m^2. It carries a point load of 3 kN at mid length and a u.d.l of 2 kN/m along its entire length. Calculate the deflection and slope at the free end by Macaulay's method. (10)

9 a) What is meant by kern of a section? Sketch the kern of i) circular and ii) square sections. (6)

b) A hollow rectangular cast iron column having outside width and depth 250×500 mm and thickness 20 mm is fixed at one end and hinged at the other end. Length of the column is 8 m. Calculate the safe load that can be applied on the column assuming a factor of safety of 4. Use Rankine's theory. Take α =1/1600 and σ_c =600 N/mm^2.Compare the value by Euler's theory. Take E= 95 kN/mm^2 (14)

Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

THIRD SEMESTER B.TECH DEGREE EXAMINATION(R&S), DECEMBER 2019

Course Code: CE201

Course Name: MECHANICS OF SOLIDS

Max. Marks: 100 Duration: 3 Hours

PART A

Answer any two full questions, each carries 15 marks. Marks

1 a) Differentiate between(i) Normal stress and shear stress (ii) Young's modulus and Rigidity modulus (iii) Poisson's ratio and volumetric strain (3)

b) A steel bar ABCD consists of three sections: AB is of 20 mm diameter and 200 mm long, BC is 25 mm square and 400 mm long and CD is of 12 mm diameter and 200 mm long. The bar is subjected to an axial compressive load which induces a stress of 30 MN/m^2 on the largest cross section. Determine total decrease in length of the bar when the load is applied. Assume E = 210 GPa (8)

c) Find the Poisson's ratio and bulk modulus of a material whose modulus of elasticity is 200 GPa and modulus of rigidity is 80 GPa. A 2 m long rod of 40 mm diameter made with the same material is stretched by 2.5 mm under some axial load. Find the lateral contraction. (4)

2 a) A linearly tapered bar with circular cross section is subjected to an axial load. Derive an expression for the change of length. (5)

b) A brass bar of 25 mm diameter is enclosed in a steel tube of 25 mm internal diameter and 50 mm external diameter. Both of them are 1m long at room temperature and fastened rigidly to each other at the ends. If the room temperature is 20^oC, find to what temperature the assembly should be heated so as to generate a compressive stress of 48.7 MN/m^2 in brass. What is the stress in steel at this temperature? Assume E_s=200 GN/m^2; E_b=100 GN/m^2; α_s=11.6 x $10^{-6}/^oC$; α_b =18.7 ×$10^{-6}/^oC$ (8)

c) Obtain the expressions for strain energy stored in a prismatic bar due to axial load. (2)

3 a) Draw the stress strain curve of mild steel and mark the salient points (6)

b) A vertically suspended bar with collar at lower end has 30 mm diameter. If a tensile load of 7500 N is applied gradually it produces an extension of 0.3 mm. Determine the height from which this load should be dropped to produce a (9)

maximum stress of 95 N/mm^2. Assume E = 200GPa

PART B

Answer any two full questions, each carries 15 marks.

4 a) A simply supported beam of span L carries a clockwise moment M at its centre. Draw the SFD and BMD (4)

b) Draw the shear force and bending moment diagrams for a cantilever beam of span 5 m subjected to a uniformly distributed load of 5 kN/m over a length of 2 m starting from the free end. (7)

c) Draw the shear stress distribution for a triangular cross section and mark the salient values. (4)

5 a) What is section modulus? Express the section modulus of (i) rectangular section (width=b, depth=d) , (ii) circular section (diameter=d) and (iii) Hollow circular section (Internal diameter=d, External diameter=D) . (5)

b) A beam of I section 200 mm wide and 300 mm deep with flange and web thickness 20 mm is used as a simply supported beam over a span of 7 m. The beam carries a distributed load of 5 kN/m over the whole span and a concentrated load of 20 kN at mid span. Determine the maximum bending stress set up and sketch the stress distribution. (10)

6 a) Obtain the relationship between bending moment, shear force and load intensity at any section of a beam. (5)

b) The intensity of loading on simply supported beam of 5 m span increases gradually from 1 kN/m at one end to 2 kN/m at the other end. Find the position and amount of maximum bending moment. Also draw the SFD and BMD. (10)

PART C

Answer any two full questions, each carries20 marks.

7 a) Derive the expression for the stresses on an oblique plane of a rectangular body when the body is subjected simple shear stress. (6)

b) A hollow shaft is of external diameter 70 mm and diameter ratio 0.8. It transmits a power of 2 HP at 25 rpm. If the maximum torque exceeds the average torque by 25%, draw the shear stress distribution across the section of the shaft indicating the values. (8)

c) Calculate minimum wall thickness of a thin cylinder 1 m in diameter if it is to withstand an internal pressure of 2 N/mm^2 and hoop stress not to exceed 40 (6)

N/mm^2. Also find change in diameter. E = 210 GPa; Poisson's ratio = 0.3.

8 a) At point in an elastic material under strain, there are normal stresses of 60 MN/m^2(tensile) and 35 MN/m^2(compressive) respectively at right angles to each other with a shearing stress of 25 MN/m^2. Find the principal stresses and position of principal planes. Find also the maximum shear stress and its plane. (10)

b) State the two theorems of determining beam deflections by moment area method. (4)

c) Determine the ratio of buckling strength of two columns one hollow and other solid, both are made of same material and have equal length, cross sectional area and same end conditions. Internal diameter of hollow column is half the external diameter. (6)

9 a) Differentiate between long column and short column. (5)

b) Derive Rankine's formula for finding the critical load of columns. (5)

c) A cantilever of length 3 m is carrying a UDL of 10 kN/m over a length of 2 m from fixed end. Find the maximum slope and deflection. Assume EI = 4×10^{12} Nmm^2 (10)

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Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Third semester B.Tech examinations (S) September 2020

Course Code: CE201
Course Name: MECHANICS OF SOLIDS

Max. Marks: 100 Duration: 3 Hours

PART A

Answer any two full questions, each carries 15 marks. Marks

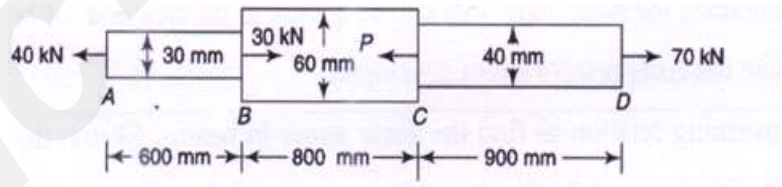
1 a) Plot stress strain diagram for mild steel. Explain its salient features. (7)

b) Calculate the diameter of a circular bar of length 10m, if the elongation of the bar due to an axial load of 100kN is 0.15mm. E=200GN/m^2 (4)

c) Define the following terms a) Poissons's ratio b)Bulk modulus c)Modulus of resilience d) Rigidity modulus (4)

2 a) Derive an expression to determine the elongation of a uniformly tapering circular section. (7)

b) A circular steel bar having three segments is subjected to various forces at different cross-sections as shown in figure. Determine the necessary force to be applied at section C for the equilibrium of the bar. Also find the total elongation of the bar. Take E=2x10^5N/mm^2. (8)



3 a) A mild steel rod of 20mm diameter and 300mm long is enclosed centrally inside a hollow brass tube of external diameter 30mm and internal diameter of 25 mm. The ends of the tube and rods are brazed together and the composite bar is subjected to an axial pull of 40kN. If E for steel and brass is 200 GN/mm^2 and 100 GN/mm^2 respectively, find the stresses developed in the rod and tube. Also, find the extension of the rod. (10)

b) A rod is 2 m long at a temperature of 10°C. Find the expansion of the rod when the temperature is raised to 80°C. If this expansion is prevented, find the stress induced in the material of the rod. Take E=1x10^5N/mm^2 and α=0.000012 per degree centigrade. (5)

PART B

Answer any two full questions, each carries 15 marks.

4	a)	A 10 m long simply supported beam carries two point loads of l0kN and 6kN at 2m and 9m respectively from the left end. It also carries a uniformly distributed load of 4kN/m run for the length between 4m to 7m from the left end. Draw shears force and bending moment diagrams. State the position and magnitude of maximum bending moment.	(10)
	b)	What are the assumptions in theory of simple bending?	(5)
5	a)	A cantilever beam of span L, fixed at the left end, carries a gradually varied load from zero at free end to w per m length at fixed end. Draw the SFD and BMD.	(6)
	b)	A 225mm x 100mm I beam is simply supported over a span of 12m. The web thickness is 7.5mm and flange thickness is 11.5mm. If the maximum permissible stress is $80N/mm^2$, what concentrated load can be carried at a distance of 4m from the support?	(7)
	c)	Define a)point of contra flexure b)Moment of resistance	(2)
6	a)	A cast iron tee section having overall depth 150mm with flange width and thickness as 100mm and 30mm respectively is used as a cantilever bracket of length 300mm. Web thickness is 30mm. If the tensile stress is restricted to $20N/mm^2$, calculate the point load that can be placed at the free end of bracket. Also calculate the compressive stress developed.	(10)
	b)	State the governing relation to find the shear stress in beams. Sketch the shear stress distribution across depth in a)rectangular section b)I section	(5)

PART C

Answer any two full questions, each carries 20 marks.

7	a)	Derive an expression for the shear stress produced in a circular shaft which is subjected to torsion. State the assumptions made in derivation.	(8)
	b)	An elemental cube is subjected to tensile stresses of $30N/mm^2$ and $15N/mm^2$ acting on two mutually perpendicular planes and a shear stress of $25N/mm^2$ on these planes. Determine magnitude and directions of principal stresses. Also calculate greatest shear stress and its planes.	(9)
	c)	Differentiate between closed coiled and open coiled helical springs.	(3)
8	a)	Show that in thin cylinders, the circumferential stress is twice the longitudinal stress when subjected to internal pressure.	(6)

b) A hollow cast iron column 10m long and 10cm internal diameter and 15cm external diameter is having its one end hinged and other rigidly fixed. Find the crippling load and safe load taking factor of safety as 5. Take E=95kN/mm^2. Use Eulers formula. (7)

c) A solid steel shaft has to transmit 75kW at 200rpm. Determine the suitable diameter of shaft if the maximum torque transmitted is not to exceed the mean by 30% in each revolution. The shear stress is not to exceed 70N/mm^2. Also calculate the maximum angle of twist in a length of 4m of the shaft. G=80Gpa (7)

9 a) A beam of length 6m is simply supported at its ends and carries a point load of 48kN and 40kN at a distance of 1m and 3m respectively from the left support. Find a) deflection under each load b) maximum deflection c) point at which maximum deflection occurs by double integration method. Given E=2x10^{5}N/mm^2 and I=85x10^{6}mm^4. (10)

b) Define slenderness ratio. State the equations for Euler's crippling load for columns with different end conditions. (5)

c) Explain moment area theorems. (5)

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