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)

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)

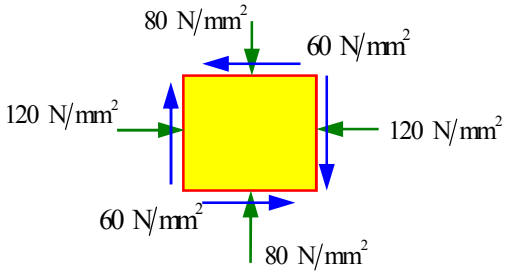

Fig. 2

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, APRIL 2018

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)	Differentiate normal and shear stress with an example.	(5)
	b)	Define elastic constants. Derive any one relation between them.	(10)
2	a)	Derive the expression for elongation of a bar due to its own weight.	(5)
	b)	A bar of 20 mm diameter is subjected to a pull of 50 kN. The measured extension on gauge length of 250 mm is 0.12 mm and change in diameter is 0.00375 mm. Calculate: i) Young's modulus ii) Poisson's ratio iii) Bulk modulus	(6)
	c)	A steel rod tapers uniformly from 20 cm diameter at one end to 5 cm diameter at the other in a length of 75 cm. How much will it stretch under an axial pull of 5 kN. Given $E = 2 \times 10^5$ kN/cm^2.	(4)
3	a)	Define strain energy and complimentary strain energy. Derive an expression for strain energy in a body subjected to axial stress.	(7)
	b)	A steel bar is placed between two copper bars each having the same area and length as the steel bar at 15°C. At this stage they are rigidly connected together at both the ends. When the temperature is raised to 315°C, the length of the bars increases by 1.50 mm. Determine the original length and the final stresses in the bars. Take $E_s = 2.1 \times 10^5$ N/mm^2, $E_c = 1 \times 10^5$ N/mm^2, $\alpha_s = 0.000012$ per °C, $\alpha_c = 0.0000175$ per °C	(8)

PART B

Answer any two full questions, each carries 15 marks

4	a)	Establish relation between load, shear force and bending moment	(5)
	b)	Construct shear force diagram and bending moment diagrams for a beam ABE, 3L/2 m long, which is supported at A and B, 'L' m long. The beam carries a concentrated load of 2W at L/4 distance from left support A, and point load W/2 at E. It also carries an upward point load of W at a distance of L/4 from support B.	(10)
5		What is pure bending? Derive an expression for bending stress in beams, stating the assumptions.	(15)
6		Determine and draw the shear stress variation along the depth of an I section beam having a uniform thickness of 10 mm, for the web and flanges. The total height of the section is 200 mm and overall width of each flange is 100 mm. The shear force is 250 kN.	(15)

PART C

Answer any two full questions, each carries 20 marks

7 a) The stresses at a point in a strained material are 50 MPa tensile and 20 MPa tensile, on two mutually perpendicular planes along with shear stress of 15 MPa. Find the principal stresses and planes on which they act. Also find the maximum shear stress and its plane. (8)

b) A thick spherical shell of inside diameter 180 mm is subjected to an internal fluid pressure of 50 MPa. Find the thickness of the shell, if the maximum permissible tensile stress in the shell is 190 MPa. (8)

c) State the differences between close coiled and open coiled spring. (4)

8 a) A hollow shaft is to transmit 300 kW power at 80 rpm. If the shear stress is not to exceed 60N/mm^2 and the diameter ratio is 0.6, find the external and internal diameters assuming the maximum torque is 1.4 times the mean. (10)

b) Derive an expression for slope and deflection of a simply supported beam with a uniformly distributed load of intensity 'w' per meter throughout the span. (10)

9 a) How can you find slope and deflection in beams using moment area method? (6)

b) Define effective length of a column. Give the effective lengths for various end conditions. (6)

c) Calculate the safe compressive load on a hollow cast iron column with one end rigidly fixed and other hinged, of 15 cm external diameter, 10 cm internal diameter and 10 m in length. Use Euler's formula with a factor of safety 5 and E = 95 kN/mm^2. (8)

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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)

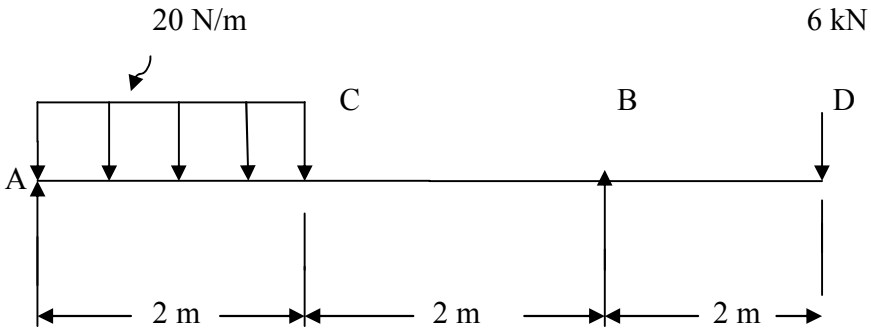
3. (a) A railway line is laid so that there is no stress in the rails at 8^0C. Calculate (a) the stress on the rails at 50^0C if there is no allowance for expansion. (b) the stress in the rails if there is an expansion allowance of 8 mm. (c) the expansion allowance if the stress in the rails is to be 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)

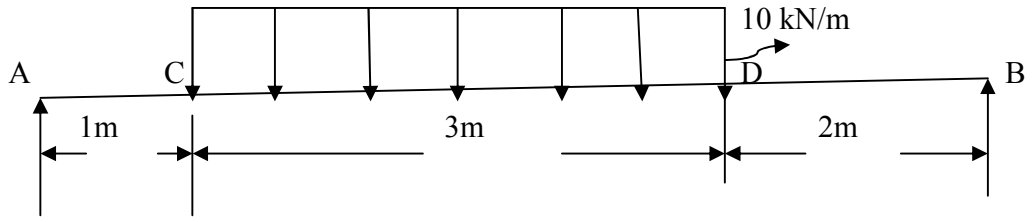
PART C

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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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)

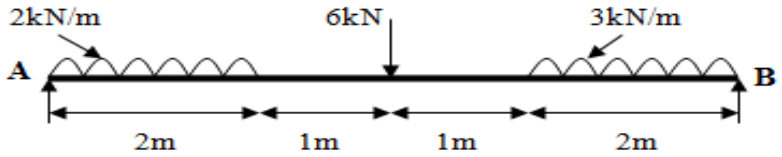
b) A compound tube consists of a steel tube 140 mm internal diameter and 160mm external diameter and an outer brass tube 160 mm internal diameter and 180 mm external diameter. The length of the compound tube is 150 mm and it carries an axial load of 900 kN. Find the stresses and load carried by each 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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