Reg. No._____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

THIRD SEMESTER B.TECH DEGREE EXAMINATION JANUARY 2017

ME 201: MECHANICS OF SOLIDS

(AU, MA, ME, MP, MT, PE, SF)

Maximum Marks: 100 Time : 3 Hours

PART – A

Answer any three questions.

1. a) Explain the stress-strain curve of a mild steel bar in tension test. (5)

b) A straight bar 450 mmlong is 40 mm in diameter for the first 250 mm length and 20 mm diameter for the remaining length. If the bar is subjected to an axial pull of 15 kN find the maximum and minimum stresses produced in it and the total extension of the bar. Take E = 2×10^5 N/mm^2. (5)

2. A bar made of brass and steel as shown in Fig.1 is held between two rigid supports A and C.Find the stresses in each material if the temperature rises by 40°C. Take $E_b = 1\times 10^5$ N/mm^2 ;$\alpha_b = 19 \times 10^{-6}$ / °C , $E_s = 2 \times 10^5$ N/mm^2 ; $\alpha_s = 12 \times 10^{-6}$ / °C

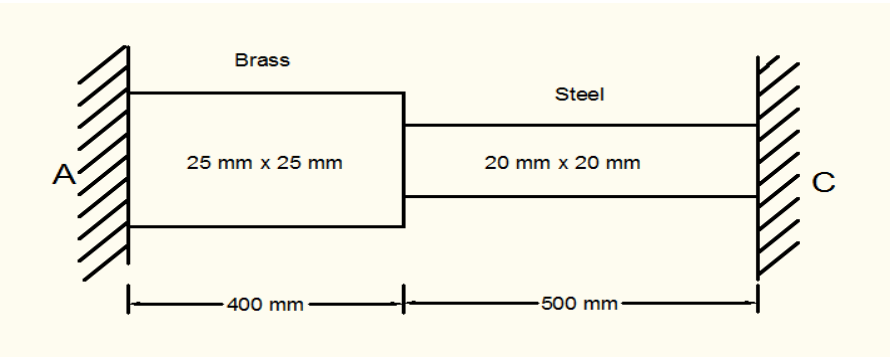


Fig : 1 (10)

3. a) What is a stress tensor? Explain different ranks of a tensor. (5)

b) A cylindrical bar is 20 mm diameter and 800 mm long. During a tensile test it is found that the longitudinal strain is 4 times the lateral strain. Calculate the modulus of rigidity and the bulk modulus, if its elastic modulus is 1×10^5 N/mm^2. Find the change in volume, when the bar is subjected to a hydrostatic pressure of 100 N/mm^2. (5)

4. A solid shaft of 6m length is securely fixed at each end. A torque of 80 Nm is applied to the shaft at a section 2 m from one end.

a) Find the fixing torques set up at the ends of the shaft. (4)

b) If the shaft is of 50 mm diameter, find the maximum shear stresses in the two portions. (4)

c) Find the angle of twist for the section where the torque is applied. (2)

Take C = 10^5 N/mm^2.

PART B

Answer any three questions

5. Draw SFD and BMD for the overhanging beam shown in Fig. 2. Locate the points of contraflexure. Also determine the maximum bending moment. (10)

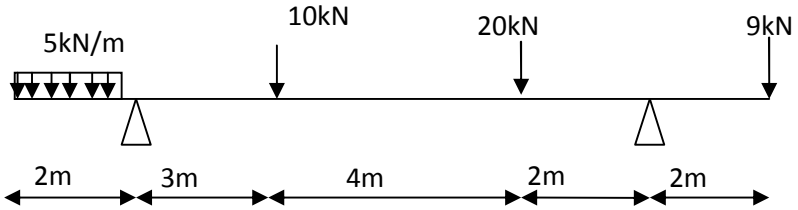


Fig. 2

6. a) Derive the relation between intensity of loading, shear force and bending moment at a section of a uniformly loaded beam. (4)

   b) A simply supported beam of length 4m carries a uniformly distributed load of 3kN/m over the central 2m length and two point loads 2kN and 3kN at distances 0.5m and 3.5m from the left support. Draw SFD and BMD. Locate the point of maximum bending moment and find out the maximum bending moment. (6)

7. a) What is pure bending? Explain with example. (4)

   b) A wooden beam 3m long is simply supported at its ends and has a cross section 200mm x 400mm. It carries a uniformly distributed load of 40kN/m over the entire span. Calculate the bending stress at a point 100mm above the bottom and 1m from the left support. (6)

8. a) Explain how beams of uniform section can be designed in practice (4)

   b) At the critical section of a I-beam, the value of vertical shear force is 40kN and the sectional dimensions are:- Flange width – 200mm, flange thickness – 30mm, web thickness - 40 mm and total depth – 300mm. Draw the shear stress distribution across the depth of the section. (6)

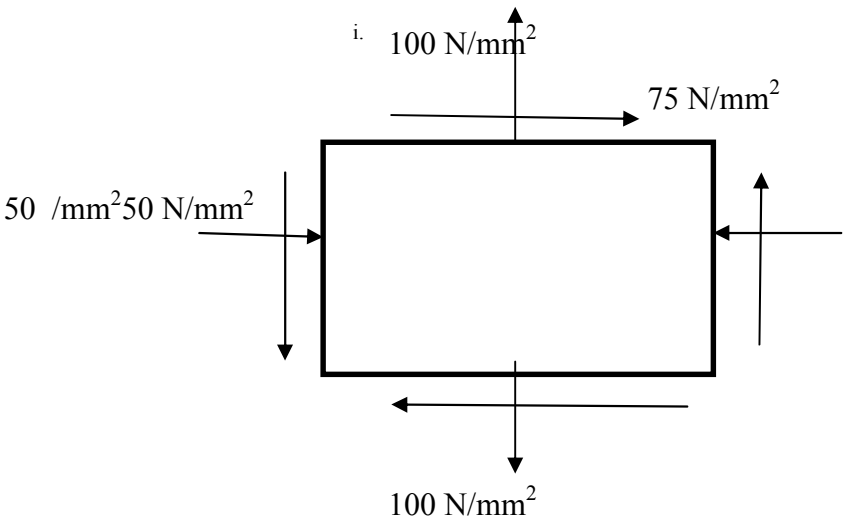
PART – C

Answer any four full questions.

9. A beam of length 6m is simply supported at its ends and carries two point loads of 48kN and 40kN at a distance of 1m and 3m respectively from the left support. Find the deflection under each load and the maximum deflection by Macaulay's method. Given E= 2x105 N/mm^2 and I= 85x106 mm^4. (10)

10. State of stress at a point in a material is 100N/mm^2 (tensile) upon a horizontal plane and 50N/mm^2 (compressive) upon a vertical plane. These planes also carry a shear stress of 75N/mm^2 as shown in fig. Determine principal stresses, maximum shear stress, plane of maximum shear stress and the resultant stress on the plane of maximum shear stress. (10)

i.



11. Explain double integration method to find the deflection of a cantilever beam with a point load at the free end (10)
12. Derive Euler's buckling load for slender columns with ends hinged (10)
13. A 1.5m long column has a circular cross section of 5cm diameter. One of the ends of the column is fixed in direction and position and other end is free. Taking factor of safety as 3, calculate the safe load using Rankin's formula, take yield stress as 560 N/mm^2 and α = 1/1600 for pinned ends (10)
14. Explain the terms:

a. Principal planes and principal stresses (5)
b. Mohr's circle of stresses (2)
c. Strain rosettes (3)

Reg. No._____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

THIRD SEMESTER B.TECH DEGREE EXAMINATION JULY 2017

ME 201: MECHANICS OF SOLIDS

(AU, MA, MP, ME, MT, PE, SF)

Maximum Marks: 100 Duration: 3 Hours

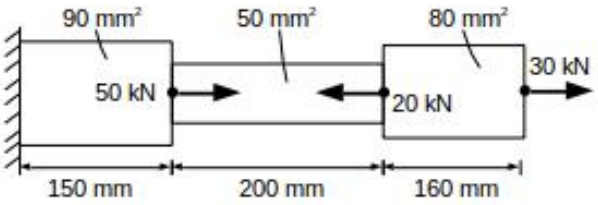
PART A

Answer any three questions.

1. a. Write two points each on linear strain and shear strain? (4)

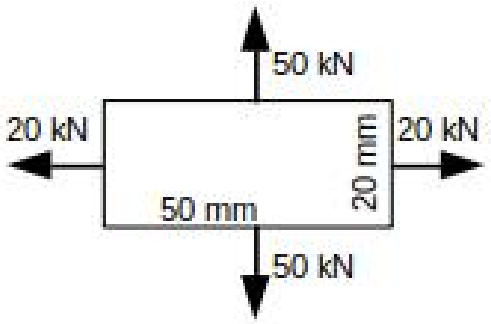
   b. Two plates of thickness 2 mm each are joined using a single rivet. The plates are subjected to a tensile load of 314 N. If the material of the rivet is having allowable shear strength of 100 MPa, determine the diameter of the rivet pin? (6)

2. A stepped bar is loaded as shown. Determine the total extension of the bar if Young's modulus is 200 GPa? (10)



3. a. Define Poisson's ratio. (2)

   b. An aluminum alloy plate of size 50 mm x 20 mm with thickness 5 mm is loaded as shown. Find the change in thickness? What must be the load to be applied to have the same change in thickness if load is applied only along thickness direction? Take Young's modulus as 1 x 10^5 MPa and Poisson's ratio as 0.25



(8)

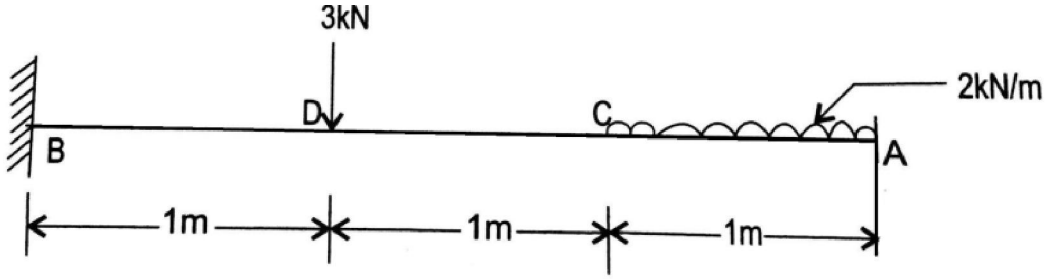
   a. List four important assumptions in the theory of torsion. (4)

   b. A shaft of 50 mm diameter is made of a material having allowable shear stress of 120 MPa. If the shaft is run at 300 rpm, what is the maximum power that can be carried by the shaft before failure? (6)

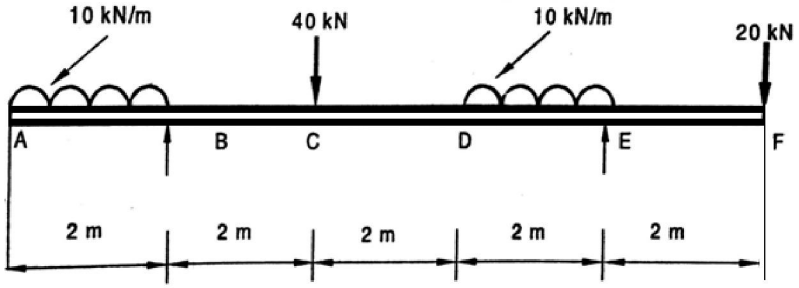
PART B

Answer any three questions.

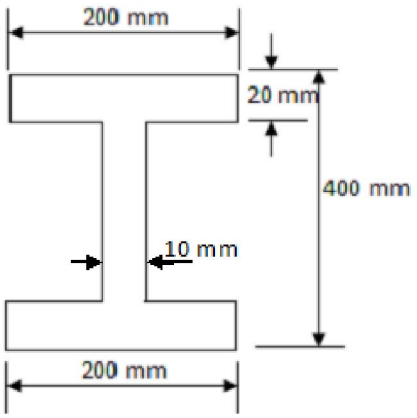
5. a. Obtain the relation between load, shear force and bending moment (5)
   b. Draw the SFD and BMD of a cantilever beam loaded as shown in figure. (5)



6. Draw the SFD and BMD for the overhanging beam shown in figure. Indicate the position and magnitude of maximum bending moment. (10)



7. a. Derive the equation for the theory of pure bending. (6)
   b. A rolled steel joist of I section has the dimensions as shown in figure. The beam carries a uniformly distributed load of 40 kN/mm^2 run on a span of 10 m, calculate the maximum stress produced due to bending. (4)



8. a. Derive the expression for shear stress in a beam. How it is distributed over the cross section of a rectangular beam? (5)
   b. A 'T' – section beam 300 mm deep and 150 mm wide has flange and web thickness of 30 mm. The length of the beam is 6 m and simply supported at its ends. It carries a UDL of 5 kN/m over its entire length. In addition to UDL, it carries a

concentrated load of 3 kN at its middle. Draw the shear stress distribution diagram for the beam. (5)

PART – C

Answer any four full questions.

9. A horizontal girder of steel having uniform section is 14 m long and is simply supported at its ends. It carries concentrated loads of 120 kN and 80 kN at two points 3 m and 4.5 m from the two ends respectively. I for the section of the girder is 16 x 108 mm^4 and Es = 210 kN/mm^2. Calculate the deflection of the girder at points under the two loads. Find also the maximum deflection. (10)

10. A rectangular block of material is subjected to a tensile stress of 110 N/mm^2 on one plane and a tensile stress of 47 N/mm^2 on a plane at right angles, together with shear stresses of 63 N/mm^2 on the same planes. Find:

    (i) The direction of the principal planes. (3)
    (ii) The magnitude of the principal stress (3)
    (iii) The magnitude of the greatest shear stress. (4)

11. At a point in a bracket the stresses on two mutually perpendicular planes are 120 N/mm^2 and 60 N/mm^2 both tensile. The shear stress across these planes is 30 N/mm^2. Find using the Mohr's stress circle the

    (i) Principal stresses and (5)
    (ii) Maximum shear stress at the point. (5)

12. A round steel rod of diameter 15 mm and length 2 m is subjected to a gradually increasing axial compressive load. Using Euler's formula find the buckling load. Find also the maximum lateral deflection corresponding to the buckling condition. Both ends of the rod may be taken as hinged. Take E = 2.1 x 10^5 N/mm^2 and the yield stress of steel = 250 N/mm^2. (10)

13. a. Derive Euler's formula for a column with one end is hinged and the other end fixed. (5)

    b. Derive the differential equation for deflection curve. (5)

14. a. What is the change in the support condition between actual beam and conjugate beam? (3)

    b. Define principal planes and principal stresses. (2)

    c. Derive an expression for Rankine's crippling load for a column. (5)

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Total Pages: 2

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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

THIRD SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2017

Course Code: ME201

Course Name: MECHANICS OF SOLIDS (ME,MP,MA,MT,AU,PE,SF)

Max. Marks: 100 Duration: 3 Hours

PART A

Answer any three full questions, each carries 10marks. Marks

1 a) Explain Hooke's law for linearly elastic isotropic material. (3)

b) A steel tie rod 40 mm in diameter and 2 m long is subjected to a pull of 80kN. To what length the bar should be bored centrally so that the total extension will increase by 20% for the same pull, the bore being 20 mm in diameter. Take E = 2 x 10^5 N/mm^2. (7)

2 a) Define the terms resilience and proof resilience. (3)

b) A copper strip 20 x 2.5 mm^2 in section is held between two strips of steel each 20 x 2.5 mm^2 in section. Find the stresses in steel and copper due to temperature rise of 6°C. Take α_s = 1.2 x 10^{-5} / °C, α_c = 1.85 x 10^{-5} / °C, E_s = 2 x 10^5 N/mm^2 and E_c= 1.2 x 10^5 N/mm^2. (7)

3 a) Define Poisson's ratio. (2)

b) A bar of circular cross section 20 mm diameter is subjected to an axial compressive load of 100 kN. The increase in diameter is found to be 0.0082 mm. Calculate the values of Poisson's ratio and modulus of elasticity. Take modulus of rigidity as 8 x 10^4 N/mm^2. (8)

4 A solid aluminium shaft 1 m long and 50 mm diameter is to be replaced by a tubular steel shaft of the same length and the same outside diameter such that each of the two shafts could have the same angle of twist per unit torsional moment over the total length. What must the inner diameter of the tubular steel shaft be? Modulus of rigidity of the steel is three times that of aluminium. (10)

PART B

Answer any three full questions, each carries 10marks.

5 A simply supported beam ABC with supports at A and B, 5m apart with an overhang BC 2m long carries a uniformly distributed load of 20 kN/m over the whole length as shown in Fig.1. Draw S.F and B.M diagrams and locate the point of contraflexure. (10)

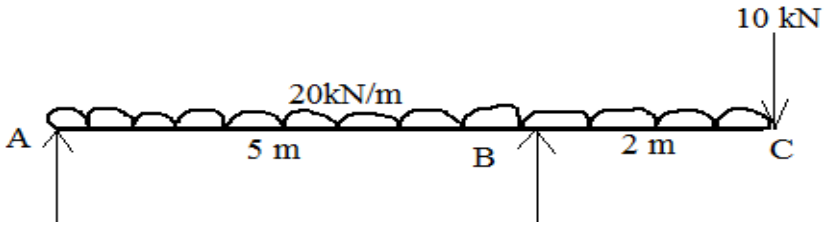

Fig. 1

6 a) What do you understand by the term 'point of inflection'? (2)

b) A simply supported beam of length 10 m carries a uniformly distributed load of 10 kN/m over a span length of 5 m from the left support. A point load of 15 kN and a moment of 10 kN-m are acting on the beam at a distance of 6.5 m and 8 m respectively from the left support. Draw the SF and BM diagrams. Find out the maximum bending moment and its location. (8)

7 Derive from fundamentals pure bending equation $\frac{M}{I} = \frac{f}{y} = \frac{E}{R}$. Also state the important assumptions. (10)

8 The T shaped cross section of a beam shown in Fig. 2 is subjected to vertical shear force of 100 kN. Calculate the shear stress at the neutral axis and at the junction of the web and the flange. Moment of inertia about the horizontal neutral axis is 1.134 x 10^8 mm^4. (10)

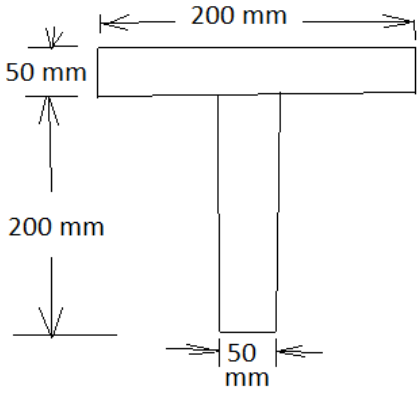

Fig. 2

PART C

Answer any four full questions, each carries 10marks.

9 A horizontal girder of steel having uniform section is 14 m long and is simply supported at its ends. It carries concentrated loads of 120 kN and 80 kN at two points 3 m and 4.5 m from the two ends respectively. I for the section of the girder is 16 x 10^8 $mm^4$and E_s = 210 kN/mm^2. Calculate the deflection of the girder at points under the two loads and maximum deflection using Macaulay's method. (10)

10 The principal stresses at a point are 200 N/mm^2 and 80 N/mm^2 both tensile. Find the normal, tangential and resultant stresses on a plane inclined at 55° to the direction of the major principal stress. (10)

11 A cantilever of uniform section has a length of AB = l, A is the free end and carries a point load W, while B is the fixed end. Find the deflection at a point C distant $\frac{l}{4}$ from the free end A. (10)

12 At a point in a bracket the stresses on two mutually perpendicular planes are 120N/mm^2 and 60 N/mm^2 both tensile. The shear stress across these planes is 30 N/mm^2. Find using the Mohr's stress circle the (10)
(i) principal stresses and
(ii) maximum shear stress at the point.

13 Derive Euler's buckling load for slender columns with one end fixed and other end hinged. (10)

14 Write short notes on the following: (10)
i) Stress and strain transformation ii) Compound stresses
iii) Rankine's crippling load for a column.

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Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

THIRD SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2018

Course Code: ME201

Course Name: MECHANICS OF SOLIDS (ME,MP,MA,MT,AU,PE,SF)

Max. Marks: 100 Duration: 3 Hours

PART A

Answer any three full questions, each carries 10 marks Marks

1 a) Derive an equation for deformation of a uniformly tapering circular rod subjected to an axial load (5)

b) A rod of length 1.5 m and diameter 30 mm is centrally bored for 500 mm length, the bore diameter being 10 mm. Under a load of 30 kN, if the extension of rod is 0.2 mm, find the modulus of elasticity (5)

2 A brass rod 25 mm diameter is enclosed in a steel tube of 50 mm external diameter and 25 mm internal diameter. The rod and tube are both initially 1.5 m long and are rigidly fastened at both ends. Find the stress in two materials when temperature rises from 30^0C to 100^0C. Modulus of elasticity for steel and brass are 200 kN/mm^2 and 100 kN/mm^2 respectively. Coefficient of thermal expansion for steel =11.6 x $10^{-6}/^0$C Coefficient of thermal expansion for brass = 18.7 x $10^{-6}/^0$C (10)

3 a) Find the modulus of rigidity & Bulk modulus of a circular rod of diameter 20 mm and length 2 m, if the longitudinal strain in the rod during a tensile stress is four times the lateral strain. Take Modulus of Elas ticity = 2.1 x 10^5 N/mm^2 (5)

b) Draw the true stress-strain curve for a ductile material (5)

4 A composite shaft has an aluminium tube of external diameter 50 mm and internal diameter 40 mm closely fitted to a steel rod of 40 mm. If the permissible stress is 50 N/mm^2 in aluminium and 120 N/mm^2 in steel , find the maximum torque carrying capacity of the compound bar.. Take Modulus of rigidity for aluminium and steel as 27 x 10^3 N/mm^2 and 80 x 10^3 N/mm^2 respectively (10)

PART B

Answer any three full questions, each carries 10 marks

5 A simply supported beam of total span 10 m carries point loads of 20 kN & 40 kN at a distance of 1.5 m and 2.5 m respectively from left support. Also a uniformly distributed load of 10 kN/m is acting over a length of 2 m starting from left end. Draw the Shear Force and Bending moment Diagram 10)

6 a) Derive the relation between load, shear force and bending moment (5)

b) Draw the SF and BM diagram for a simply supported beam of total span 6 m subjected to a clockwise bending moment of 24 kN-m at a point 4 m from left support. (5)

7 A simply supported beam of total span 8 m carries a central concentrated load (10)

of 10 kN. The beam is of I-Section. The dimensions of I section are: top flange 200 mm x 50 mm, Web 200 mm x 50 mm, Bottom flange 130 mm x 50 mm. Determine the maximum bending stress.

8 Draw the shear stress distribution diagram for an symmetrical I-section subjected to shear force of 40 kN.The dimensions of I-section are : Top flange : 80 mm x 20 mm, web 200 mm x 20 mm , bottom flange 80 mm x 20 mm (10)

PART C

Answer any four full questions, each carries 10 marks.

9 A simply supported beam of span 9 m carries a uniformly distributed load 20 kN/m as shown in fig 1. Determine deflection of beam at midpoint of beam and also maximum deflection. Take flexural rigidity = 10 x 10^4kN m^2 (10)

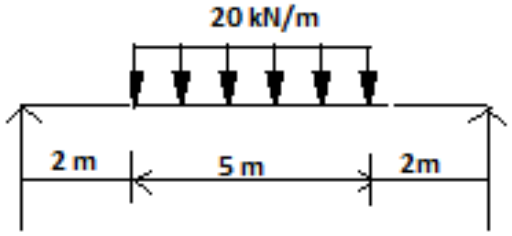

Fig:1

10 A Simply supported beam of length 6 m carries a point load of 10kN at a distance of 2 m from the right support. Determine slope at left support and deflection under point load using conjugate beam method. Take E =2 x 10^5 N/mm^2 and Moment of Inertia = 2 x 10^8 mm^4 (10)

11 In an elastic material, at a certain point, on planes at right angles to one another, direct stresses of 130 N/mm^2 tensile and 110 N/mm^2 compressive are acting. The major principal stress in the material is to be limited to 150 N/mm^2. To what shearing stress the material may be subjected on the given planes. Also find the minimum principal stress and the maximum shearing stress at that point (10)

12 Derive an equation for Euler's crippling load for a column whose both ends are fixed (10)

13 A shear force of 40 kN and a bending moment of 20 kN-m act at a certain cross section of rectangular beam 100 mm wide and 200 mm deep. Find the principal stresses at a point 20 mm below the top surface (10)

14 A hollow cast iron column has 200mm outside diameter, 150mm inner diameter and is 6m long. Both ends of the column are pinned. Using Rankine's formula, calculate the crippling load on the column. Take σ_c=550N/mm^2 and Rankine's constant as 1/1600. Compare load by Euler's formula E = 110GPa (10)

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Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

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

Course Code: ME201

Course Name: MECHANICS OF SOLIDS (ME,MP,MA,MT,AU,PE,SF)

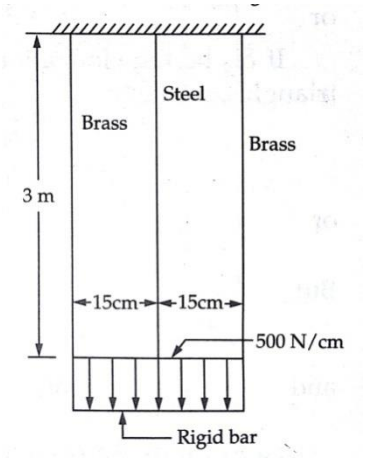
Max. Marks: 100 Duration: 3 Hours

PART A

Answer any three full questions, each carries 10marks Marks

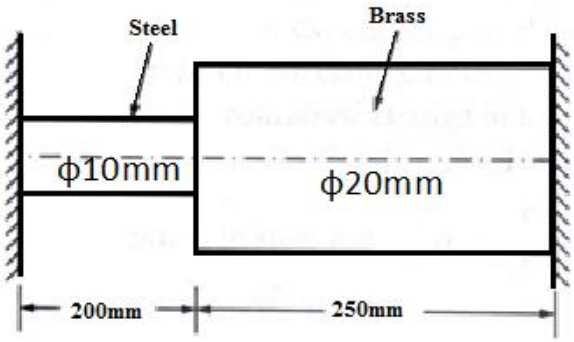
1 a) Explain the salient points of a typical stress-strain curve for a mild steel rod subjected to tension test. (5)

b) Three long parallel wires equal in length and in the same plane are supporting a rigid bar connected at their bottom, as shown in fig. The middle wire is of steel while the other two are of brass. All the wires are of $1cm^2$ cross-sectional area. The rigid bar supports a UDL as shown in the figure. Determine the forces and elongation of wires. Take Modulus of elasticity of steel, $E_s = 200\ GN/m^2$ and that of brass $E_b = 100\ GN/m^2$. (5)



2 a) Define strain energy and explain how it is stored in a body? (3)

b) A composite bar made of brass and steel is fixed between two supports as shown in the figure. If the temperature is increased by 80^0C, find the stresses induced in the steel and brass section assuming (i) the supports do not yield (ii) the supports yield by 0.15mm. Take $E_s = 200$ GPa, $E_b = 100$ GPa, $\alpha_s = 12\times10^{-6}\ /^0C$ and $\alpha_b = 19\times10^{-6}\ /^0C$. (7)



3 A rectangular block of metal of 50mm×25mm cross-section and 125mm length carries a tensile load of 100kN along its length, a compressive load of 1MN on its 50mm×125mm faces and a tensile load of 400kN on its 25mm×125mm faces. If E = 208GN/m^2 and υ = 0.3, find (a) change in volume of bar (b) increase required in 1MN load to produce no change in volume. (10)

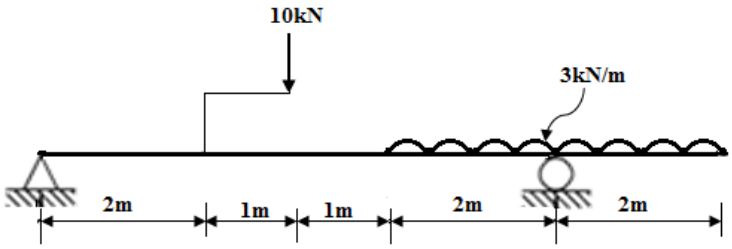
4 a) Define Torsional rigidity. (2)

b) A 3m long solid shaft transmits 15kW at 1200rpm. Find the required diameter of the shaft, assuming that maximum shear stress in the shaft is limited to 25MPa and angle of twist is not to exceed 5^0. Take G=80GPa. (8)

PART B

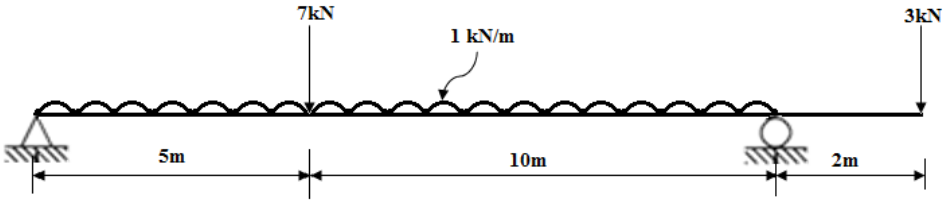
Answer any three full questions, each carries 10marks

5 Draw the shear force and bending moment diagrams for a beam shown in the figure given below. Also determine the value of maximum bending moment. (10)



6 a) Define point of contraflexure. (2)

b) Draw the shear force and bending moment diagrams for a beam shown in the figure given below. Locate the point of contraflexure. (8)

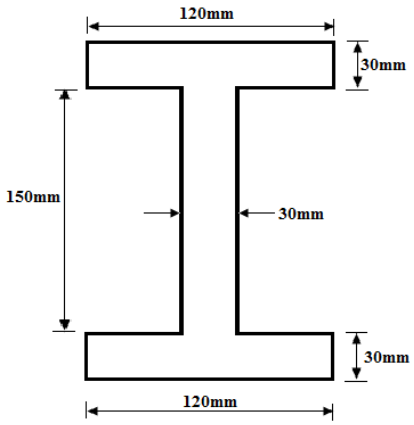


7 a) Derive the equation of theory of pure bending. (6)

b) A rectangular section is to be cut from a circular log of wood of diameter 500mm. Find the dimensions of strongest section in bending (4)

8 a) Derive an expression for determining shear stress distribution in a rectangular cross-section of width 'b' and depth'd' and determine the maximum shear stress. (4)

b) An I-section beam shown in the figure given below is subjected to a shear force of 50kN. Draw the shear stress distribution diagram. (6)



PART C

Answer any four full questions, each carries 10marks.

9 Two point loads of 5kN and 15kN are acting on a 5m simply supported beam at 1m and 2m respectively from the left end. Find the defections under the applied loads. Also find the position and magnitude of maximum deflection. (10)

10 a) Obtain an expression for maximum slope and deflection of a simply supported beam subjected to a concentrated load 'W' at mid-span. (6)

b) Differentiate plane stress and plane strain conditions giving examples. (4)

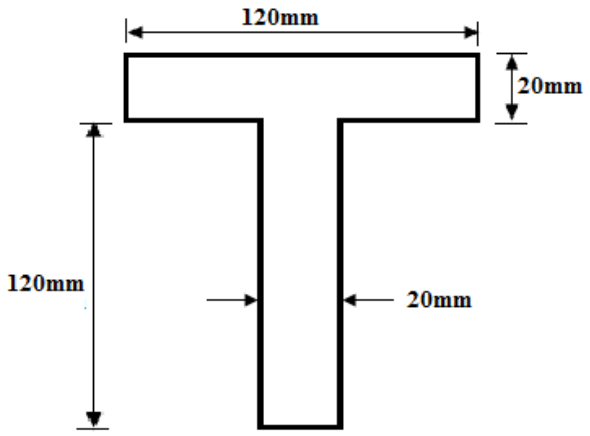
11 At a point in an elastic material under strain, there are normal stresses of 60MPa (tensile) and 35MPa (compressive) respectively at right angles to each other with a shearing stress of 25MPa. Find the principal stresses and position of principal planes. Also find the maximum shear stress and its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

12 A member is subjected to stresses on two mutually perpendicular planes which are 120MPa (tensile) and 60MPa (tensile). Shear stress across these planes is 30MPa. Find the principal stresses and maximum shear stress at a point by using Mohr's circle. (10)

13 a) Derive expressions for equivalent bending moment and equivalent torque for a shaft subjected to a bending moment 'M' and torque 'T'. (8)

b) What is meant by slenderness ratio? (2)

14 The figure given below shows a T-section column of mild steel 4m long with both ends hinged. Determine the Euler's crippling load. Take E=200GPa (10)



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Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

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

Course Code: ME201

Course Name: MECHANICS OF SOLIDS (ME, MP, MA, MT, AU, PE, SF)

Max. Marks: 100 Duration: 3 Hours

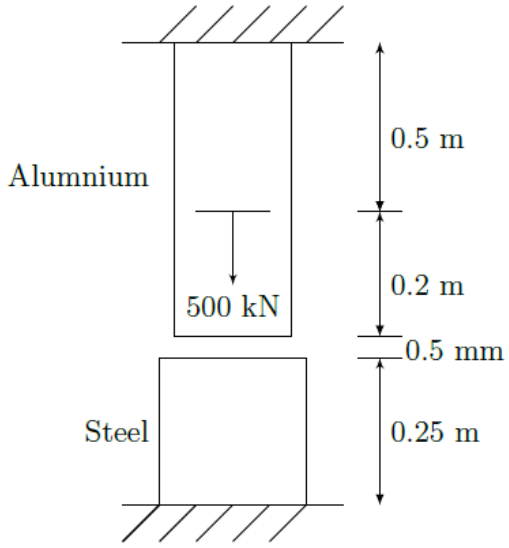
PART A

Answer any three full questions, each carries 10marks Marks

1 A bar 460 mm long is of diameter 25 mm for an initial length of 200 mm and 40 mm diameter for the remaining length. Find the stresses produced in the individual sections for an applied load of 20 kN and the total elongation. Take E as 200 GPa. (10)

2 a) Define isotropic and orthotropic material? (3)

b) Figure shows an aluminium bar of 700 mm length and of 1250 mm^2 cross sectional area suspended from the ceiling so that its clearance is 0.5 mm between it and a steel bar of 250 mm length and of 2500 mm^2 cross sectional area. Find the stress in the two bars when 500 kN of load is applied at 500 mm from the ceiling, Ea=70 GPa and Es=210 GPa. (7)



3 A brass rod 30 mm diameter is enclosed in a steel tube of 50 mm external diameter and 30 mm internal diameter is initially kept at room temperature of 28˚C. The ends of rod and tube which are of length 1.6 m are fastened. Find the stresses developed in both the materials when the temperature is raised to (10)

100˚C. The Young's modulus for steel and brass are respectively 200 kN/mm^2 and 100 kN/m^2. The coefficient of thermal expansion values for steel and brass are respectively 11.6 x 10^{-6}/ ˚C and 18.7 x 10^{-6}/ ˚C.

4 a) Derive the torsion formula with assumptions. (8)

b) Define the term torsional rigidity. (2)

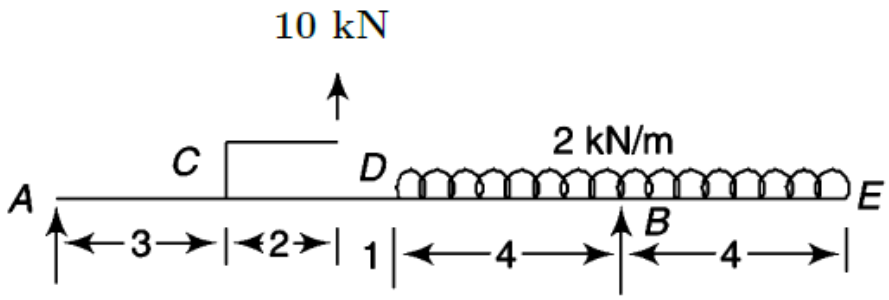
PART B

Answer any three full questions, each carries 10marks

5 a) Distinguish between roller and hinged support. (2)

b) A simply supported beam has a span of 9 m and carries a uniformly distributed load of 20 kN/m over the whole span along with two, point loads of 30 kN and 40 kN at 6 m and 7.5 m respectively from the left-hand support. Draw the shear force and bending moment diagrams indicating values at the point loads. (8)

6 A 14-m simply supported beam with an overhang at the right end is loaded as shown in Fig. It carries a load of 10 kN applied through a bracket and also a uniformly distributed load for 8 m length from the right end. Draw the shear force and bending moment diagram. Also find point of contra flexure. (10)



7 a) Discuss the significance of flexural rigidity in the design of beams. (3)

b) A simply supported 150 mm wide, 300 mm deep and 4 m long beam carries a uniformly distributed load of 15 kN /m throughout the span. Determine the maximum bending stress and also determine the bending stress at the point which is 50 mm below the top surface and 1.2 m from the left support. (7)

8 At critical section of a I beam, the value of shear force is 45 kN and the sectional dimensions are: flange width 200 mm, flange thickness 30 mm, web thickness 30 mm and the total depth is 300 mm. Draw the shear stress distribution across the depth of the section. (10)

PART C

Answer any four full questions, each carries 10marks.

9	a)	A cantilever of uniform section has a length 'l' and carries a point load W at the free end. Find the deflection at a point 'l/3' from the fixed end.	(7)
	b)	State the significance of stress transformation equations	(3)
10		A simply supported beam of length 6 m carries a uniformly distributed load of 10 kN/m from 1 m and ending at 4 m from left end. Using Macaulay's method calculate i) Slope at left end. ii) Deflection at mid span. iii) Maximum deflection. Take E=200 Gpa and Moment of inertia I=$450x10^6$ mm^4	(10)
11		The normal stresses at a point in an elastic material are 100 MPa (tensile) and 60 MPa (compressive) respectively at right angles to each other with shearing stress of 50 MPa. Determine the i) Principal stresses and the position of principal planes ii) Maximum shear stress and its plane.	(10)
12	a)	The two-dimensional state of stress in a body is $\sigma=\begin{bmatrix} 0 & 60 \\ 60 & 0 \end{bmatrix}$ in Mpa. Using Mohr's circle method, determine the principal stresses, location of principal planes, maximum shear stress and its planes.	(7)
	b)	Define two-dimensional state of stress.	(3)
13	a)	Write short note on strain rosette.	(3)
	b)	A shaft at a certain cross section of 120 mm diameter is subjected to a bending moment of 5 kN-m and twisting moment 10 kN-m. Find the principal stresses and maximum shear stresses.	(7)
14	a)	Define the term equivalent length and slenderness ratio of column.	(4)
	b)	A 4 m long column with both ends firmly fixed supports an axial load of 500 kN. The inside diameter of the column is 0.5 times the outside diameter. Determine the inside and outside diameter of column. Assume factor of safety to be 5, crushing stress 560 MPa and Rankine constant 1/1600.	(6)

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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Third semester B.Tech examinations (S) September 2020

Course Code: ME201

Course Name: MECHANICS OF SOLIDS (ME,MP,MA,MT,AU,PE,SF)

Max. Marks: 100 Duration: 3 Hours

PART A

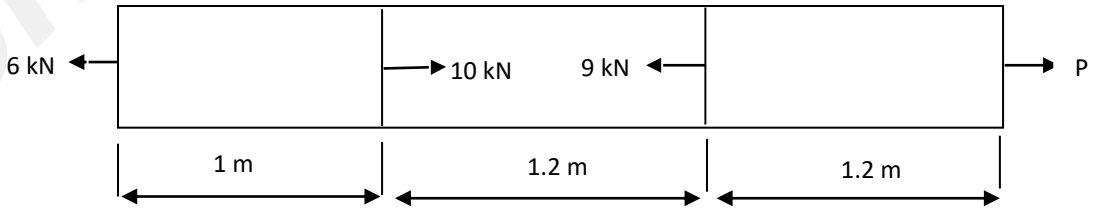
Answer any three full questions, each carries 10 marks Marks

1 a) Explain the stress strain diagram for brittle material. (3)

b) A compound bar is made of central steel plate of 60mm wide and 10mm thick to which copper plates 40mm wide by 5mm thick are connected rigidly on each side. The length of bar at normal temperature is 1metre. If temperature is raised by 80^0C, determine the stresses in each metal and change in length. Take E_{STEEL}= 200GPa α_{STEEL}=12x$10^{-6}/^0$C&E_{COPPER}= 100GPa α_{COPPER}=17x$10^{-6}/^0$C. (7)

2 a) ABC is a stepped bar subjected to axial pull of 40 KN.The length and diameter of the solid portion AB is 80 mm and 40mm and for the remaining hollow section of length 120mm is having internal diameter 20 mm external diameter 40mm.Determine total strain. What will be the diameter of the bar,if it is a solid section throughout, for the same strain. Take E=200 KN/mm^2. (6)

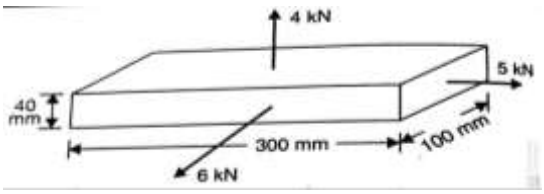
b) A steel member of uniform cross-sectional area 1000mm^2 is subjected to axial force as shown. Calculate the force "P" required for equilibrium of the member and the total change in length. (4)



3 a) With proper assumptions derive torsion equation. (5)

b) A metallic bar 300mmx 100mm is subjected to a force of 5KN,6KN&4KN along x,y and z directions respectively.Determine change in volume of the block. (5)

Take E=2x10^5 N/mm^2 and Poisson's ratio=0.25.



4 a) Determine the diameter of a solid shaft which will transmit 440kW at 280 rpm.The angle of twist should not exceed one degree per meter length and maximum torsional shear stress is limited to 40N/mm^2.AssumeG=84KN/mm^2. (6)

b) A rod of 1m length and diameter 20mm is subjected to tensile load of 20kN.The increase in length of rod is0.30 mm and decrease in diameter is 0.0018mm. Calculate Poisson's ratio, Young's modulus, Bulk modulusand rigidity modulus. (4)

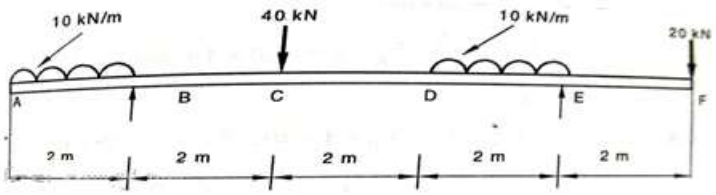
PART B

Answer any three full questions, each carries 10 marks

5 Draw shear force and bending moment diagram for the beam shown& mark its salient points. (10)

6 a) What do you understand by term point of inflection (2)

b) Draw shear force & bending moment diagram, indicate the magnitude of maximum bending moment and its position (8)



7 In a simply supported beam of 3 m span with 'T' cross section, a point load of 15kN is applied at a distance of 1 m from the left end. The flange width and thickness are 100 mm and 50 mm respectively. The total depth of the 'T' cross section is 300 mm and the web thickness is 50 mm. Determine the shear stress at a point 30 mm below the top of the flange at mid-span of the beam. Also plot the shear stress distribution across the depth of the beam. (10)

8		Derive the relation connecting bending moment and bending stress for a beam subjected to pure bending. State all assumptions.	(10)

PART C

Answer any four full questions, each carries 10 marks.

9	a)	Discuss on stress transformation.	(2)
	b)	Determine the equation of deflection curve for a cantilever beam subjected to a uniform distributed load of q per unit length.	(8)
10		A simply supported beam of span 10 m carries a uniformly distributed load of 5 kN/m over a length of 5 m from the centre to the right end. Calculate the deflection at the centre and slope at the right end. The beam has a rectangular cross section of height 200 mm and width 100 mm. Take E as 205 GPa.	(10)
11		At a point in a material, the stresses on two mutually perpendicular planes are 120 N/mm^2 and 40 N/mm^2 both tensile. The shear stresses across these planes is 40 N/mm^2. Determine the principal stresses. Locate the principal planes and determine the normal and shear stresses on a plane inclined at 45 degrees in anticlockwise direction from the major principal plane.	(10)
12		Derive Euler's buckling load for a slender column with one end fixed and other end hinged.	(10)
13		A solid shaft of 150 mm diameter is transmitting a torque of 120kNm.At the same time it is subjected to abending moment of 12kNm and an axial thrust of 200kN. Find the maximum & minimum Principal stresses developed at the extreme fibre along vertical axis.	(10)
14	a)	Define slenderness ratio and explain its significance.	(3)
	b)	The external and internal diameter of hollow cast iron column is 5cm and 4cm respectively. If length of this column is 3m and both of its ends are fixed, determine the crippling load using Rankine's formula. Take σ_c=550$N/mm^2$and α=6.25x10^{-04}	(7)

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