Reg No.:_____ Name:_____

0800CET201122003

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Third Semester B.Tech Degree Examination December 2020 (2019 Scheme)

Course Code: CET201
Course Name: MECHANICS OF SOLIDS

Max. Marks: 100 Duration: 3 Hours

PART A

Answer all questions. Each question carries 3 marks Marks

1	With help of stress-strain diagram, briefly explain Hooke's Law.	(3)
2	Define Factor of Safety. Calculate the working load on a cantilever beam if it carries an ultimate load of 100 kN with a factor of safety of 2.	(3)
3	Use neat sketches to illustrate the concept of shear stress and shear strain.	(3)
4	Define Poisson's ratio. Also state the relationship between the elastic constants.	(3)
5	Define Bending moment and Shear force.	(3)
6	What do you mean by point of contraflexure? State its significance.	(3)
7	Write the equation of simple bending and state each term involved in it.	(3)
8	Using the case of a simply supported beam with constant width, illustrate the concept of beams of uniform strength.	(3)
9	Define the terms: Principal stress and principal planes.	(3)
10	What is slenderness ratio? State its significance.	(3)

PART B

Answer any one full question from each module. Each question carries 14 marks

Module 1

11	The steel bar shown fig:1 has the following dimensions: Total length – 2400mm; 18 mm diameter for half the length and 12 mm diameter for the remaining half. (i) If the bar is subjected to a tensile force of 22.5kN, Calculate the normal stress and normal strain in the segment AB and BC respectively. (ii) Also find the total extension of the bar when it is subjected to a tensile force of 22.5kN. (iii) What would be the extension of a steel bar of uniform diameter having the same length and same volume when subjected to the same tensile force?	(14)

Take E = 200GPa

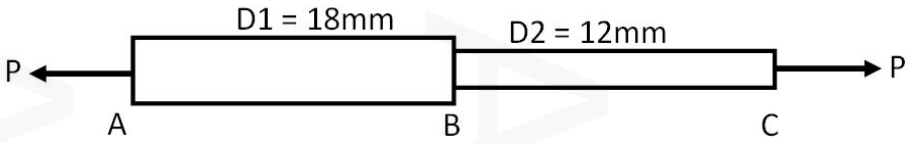

Figure 1

12 A rigid beam AB of length 2.4m is hinged at A and supported by two steel wires as shown in fig:2. The steel wire CD has a length 6m and diameter 12mm supports the beam at distance(AD) 0.6m from hinge A; the steel wire EF has a length 3m and diameter 3mm supports the beam at distance(BF) 0.6m from end B.. If the beam supports a concentrated load of 2.25kN at the end B, Calculate: (14)

i) The tension in each wires
ii) The stress in each wires
iii) Deflection of beam at points D, F, & B.

Take E = 200GPa.

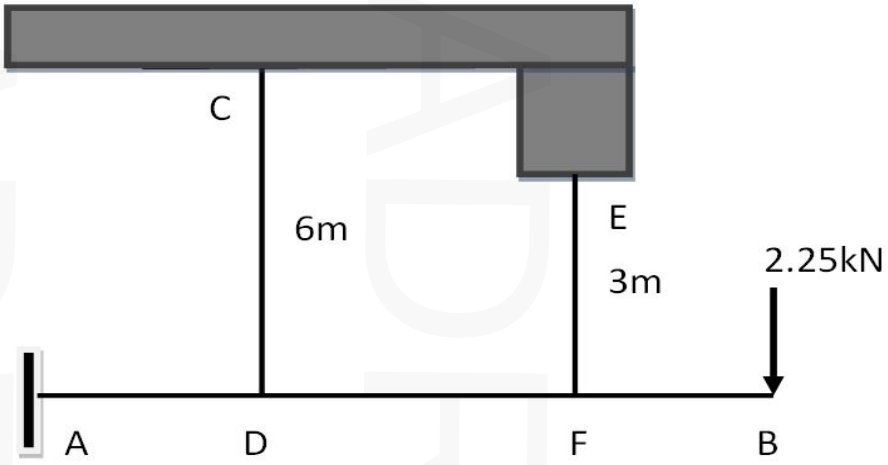

Figure 2

Module 2

13 A steel rod AB of length 900mm and diameter 25 mm has a bronze sleeve BC of length 300mm and external diameter 30 mm securely bonded to it as shown in fig:3. For a rise in temperature of 200 degree Celsius, calculate: (14)

i) Stresses in steel rod and bronze sleeve respectively.
ii) Compressive force developed in bronze sleeve.
iii) Elongation of bronze sleeve
iv) Total elongation of steel rod

Take E_S=200GPa , E_B=100GPa & α_S=1.2 x 10^{-5} per °C , α_B=2.03 x 10^{-5} per °C

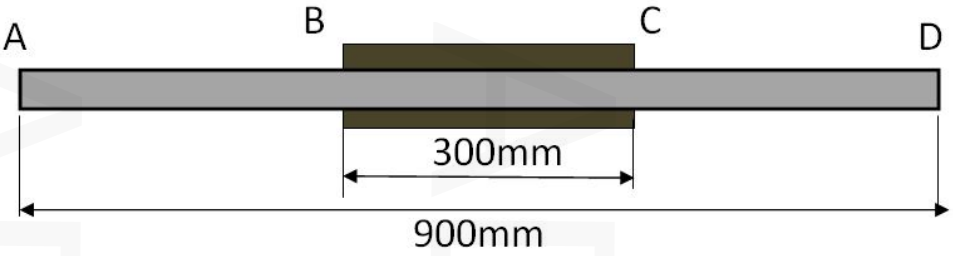

Figure 3

14.a What is strain energy? Derive expression for strain energy developed in rod subjected to axial loading only. (4)

b A thick cylinder of internal diameter 400mm and external diameter 600 mm is subjected to an external pressure of 4 MPa. (10)

i) Sketch variation of radial pressure across the thickness of the wall.

ii) Sketch variation of hoop stress across the thickness of the wall.

iii) Find the internal pressure that can be applied for a limiting hoop stress of 15 MPa.

Module 3

15 A horizontal beam ABCD has a total length of 10m and carries uniformly distributed load of 0.18kN/m over the entire length of the beam. The beam also carries a concentrated load of 0.2kN at the left end A. The beam is supported on two points (B & C) 7m apart such that each support carries the total load equally. Calculate: (14)

i) The length of the overhanging portions AB & CD.

ii) Draw the Shear force diagram and Bending moment diagram.

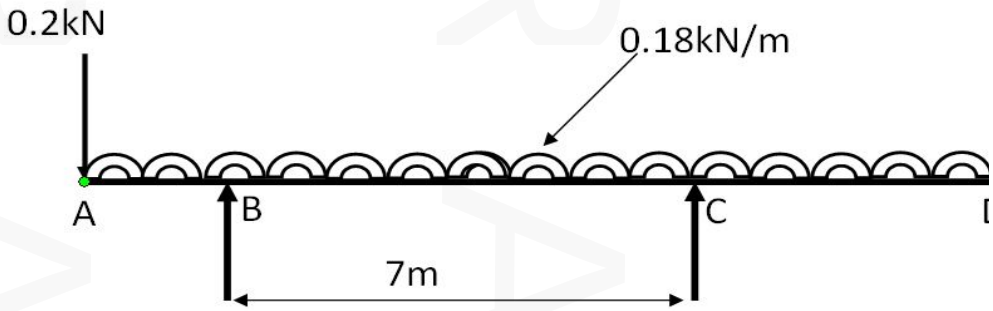

Figure 4

16 Analyse the overhanging beam shown in fig:5. Draw the shear force diagram and bending moment diagram shown all salient points including point of contraflexure. (14)

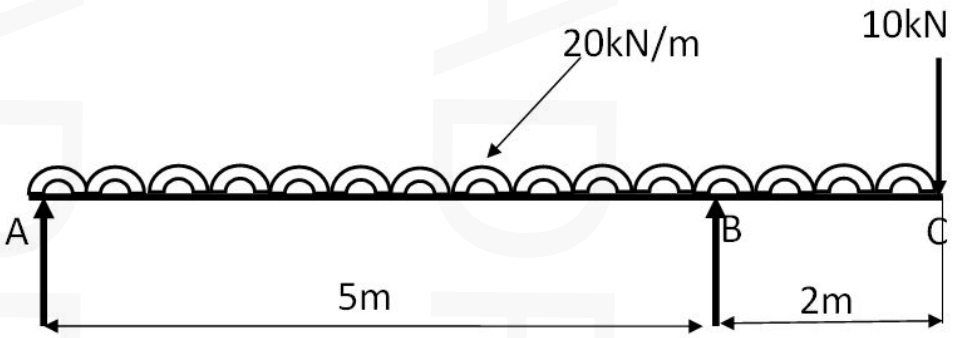

Figure 5

Module 4

17 A simply supported beam AB of 5m span is carrying a uniformly distributed load of 20kN/m. The beam is made up of rectangular cross section of dimensions 300mm x 450 mm. (14)

i) Draw the bending stress distribution at the critical section for bending.

ii) Draw the shear stress distribution considering the critical section for shear.

iii) Also calculate bending stress and shear stress on layer located 50mm above the neutral axis on the cross section at the mid-point of the beam.

iv) Assess whether the beam can safely carry the loads given the allowable stresses in bending and shear are 8MPa and 0.75 MPa respectively.

18.a Derive the expression for strain energy due to bending deformation. (4)

b For the simply supported beam shown in fig:6, calculate the total elastic strain energy due to bending. (10)

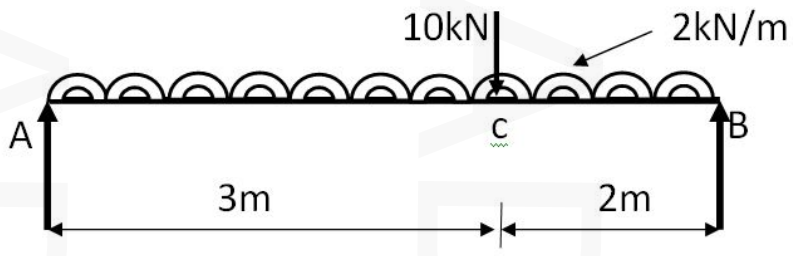

Figure 6

Module 5

19 A rectangular element ABCD of an elastic material is subjected to a shear stress of 17.5 MPa. The planes at right angles carry tensile stress of 70 MPa and compressive stress of 35 MPa respectively. (14)

Determine:

i) The magnitude of the principal stresses.

ii) The direction of the principal planes.

iii) The magnitude of maximum shear stress.

iv) The orientation of the plane of maximum shear stress.

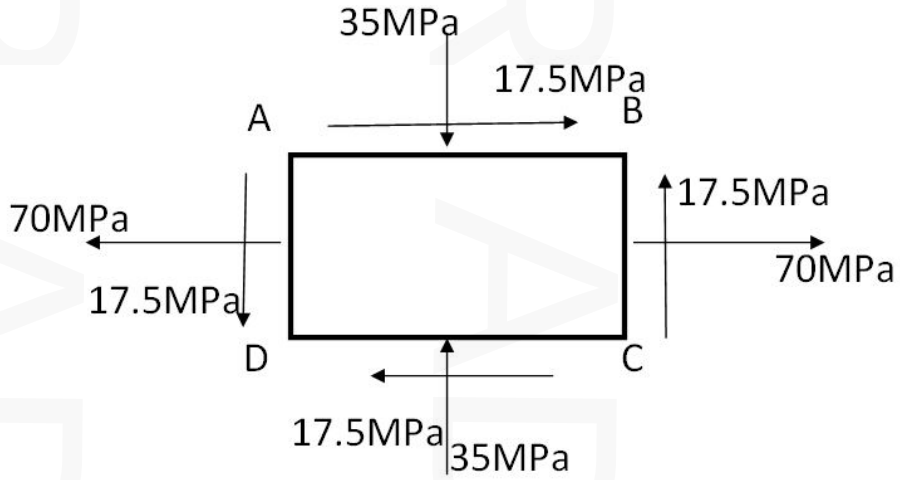

Figure 7

20.a A short column having a length of 0.5 m and made of solid aluminium rod of 25mm diameter is pinned at both the ends. Determine the Euler's critical load for the column. If in order to reduce the weight of the member by 25%, the cross section is changed to hollow circular section of 25 mm external diameter, determine the critical load of the modified column. Also determine the percentage reduction in critical load due to cross section modification. Take E = 72.8 GPa. (8)

b A hollow circular shaft of 30 mm outer radius transmits a power of 180 kW while rotating at a frequency of 25 Hertz. Find the thickness of the circular shaft if the allowable shear stress is 60MPa. (6)

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