Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Third Semester B.Tech Degree Examination December 2021 (2019 scheme)

Course Code: MRT205

Course Name: MECHANICS OF SOLIDS

Max. Marks: 100 Duration: 3 Hours

PART A

Answer all questions. Each question carries 3 marks Marks

1 Write down the equilibrium equations (3)

2 What are principal stresses and planes? (3)

3 Write the constitution equation connecting the relationship between strain and stress components? (3)

4 Derive the relationship between K, E and υ (3)

5 Explain strength equation and stiffness equation for a shaft subjected to pure torsion (3)

6 Define (3)

a)flexural rigidity

b) section modulus

7 Write the expression for strain energy on a body subjected to uniaxial normal stress (3)

8 Define castigliano's second theorem (3)

9 State any three assumptions made in Euler's equation (3)

10 Write the Rankine's crippling load formula? (3)

PART B

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

Module 1

11 At a point P in a body, σ_x = 10,000 N/cm^2 (1020 kgf/cm^2), σ_y = –5,000 N/cm2 (–510 kgf/cm^2), σ_z = –5,000 N/cm^2, $t_{xy} = t_{yz} = t_{zx}$ = 10,000 N/cm^2. Determine the normal and shearing stresses on a plane that is equally inclined to all the three axes. (14)

12 The state of stress at a point given by the Cartesian stress tensor $\begin{bmatrix} 3 & -1 & 1 \\ -1 & 5 & -1 \\ 1 & 1 & 3 \end{bmatrix}$ kPa Find a) (14)

the three stress invariants b)characteristic equation c)principal stresses d) unit normals of the principal planes

Module 2

13 a) A steel bar is placed between two copper bars each having the same area and length as steel bar at 20^0c. At this stage they are rigidly connected together at both the ends when the temperature is raised at 320^0c, the length of the bar increases by 1.5mm Determine the original length and final stresses in the bars (9)

Take Es = 220GN/m^2, Ec = 110 GN/m^2, $\alpha_s = 0.000012 \text{per}^0\text{C}$, $\alpha_c = 0.0000175 \text{per}^0\text{C}$

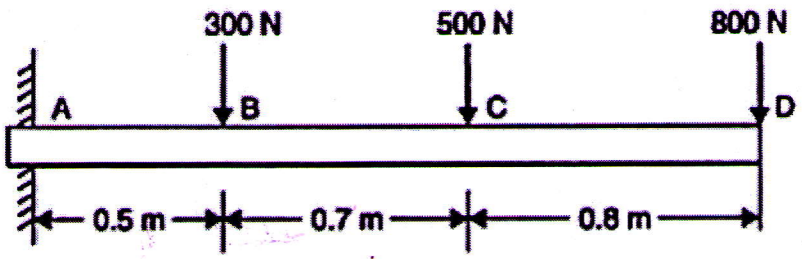
b) Draw the stress strain diagram for a ductile material and explain the salient points? (5)

14 a) Define the elastic constants and derive the relationship between Modulus of elasticity, modulus of rigidity and bulk modulus (7)

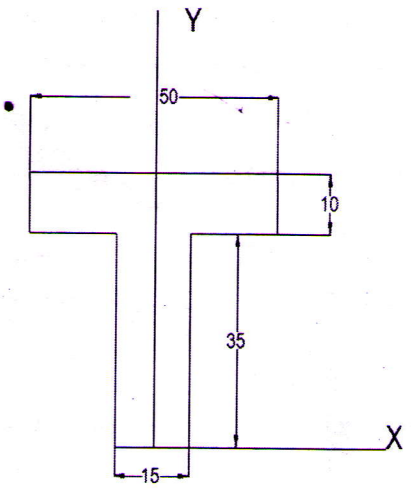
b) Determine the poisson's ratio and bulk modulus of a material, for which young's modulus is 1.2 x 10^5 N/mm^2 and modulus of rigidity is 4.8 x 10^4 N/mm^2 (7)

Module 3

15 A cantilever beam of length 2 m carries the point loads as shown in Fig. Draw the shear force and B.M. diagrams for the cantilever beam (14)



16 a) A cantilever beam cross section is as shown in figure .The beam carrying an UDL of 8kN/m .If the length of beam is 2.5 m determine the maximum tensile and compressive stresses in beam (9)



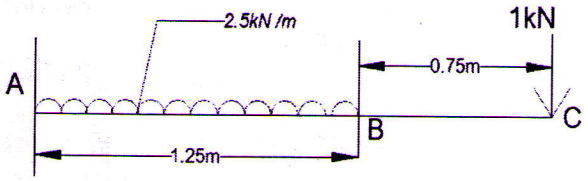
(5)

b) State any three assumptions in the theory of simple bendng

Module 4

17 a) A cantilever of length 2m carries a UDL of 2500N/m for a length of 1.25m from the fixed end and a point load of 1000N at the free end. If the section is rectangular 120mm wide and 240mm deep .find the slope at the free end (8)

$E = 10000N/mm^2$



b) Derive the expressions for elastic strain energy in terms of applied load/moment and material property for the cases of a) Axial force b) Bending moment. (6)

18 Find an expression for strain energy stored in a body when

a) The load is applied gradually (7)

b) The load is applied suddenly (7)

Module 5

19 Derive an expression for circumferential stress and longitudinal stress for a thin shell subjected to an internal pressure (14)

20 a) A cylindrical shell 3m long which is closed at the ends has an internal diameter of 1m and a wall thickness 15mm .Calculate the circumferential and longitudinal stresses induced and also change in dimension of the shell if it is subjected to an internal pressure of 1.5 MN/m^2 E = $200GN/m^2$ 1/m = 0.3 (9)

b) Explain any two theories of failure (5)