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Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S7 (S, FE) Examination May 2024/ S5 (PT) (S,FE) Examination June 2024 (2015 Scheme)

Course Code: ME401

Course Name: DESIGN OF MACHINE ELEMENTS - I

Max. Marks: 100 Duration: 3 Hours

Use of Machine Design data book is permitted

PART A

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

1 a) Differentiate standardization and codes giving examples. (5)

b) Define factor of safety and give its significance. What are the factors considered for the selection of factor of safety? (5)

c) Explain the procedure to determine the endurance limit of a material. (5)

2 a) Explain the factors which governs the selection of material for a given machine element. (3)

b) Explain the steps involved in design process. (6)

c) The state of stress at a point in a machine member is $\begin{bmatrix} 180 & 80 & 0 \\ 80 & 120 & 0 \\ 0 & 0 & 0 \end{bmatrix} MPa$. Find (i) the principal stresses, and (ii) directions. (6)

3 a) State and explain Von-Mises theory. Also plot the region of safety. (5)

b) What are the properties of material required to resist impact load? (4)

c) A bolt in a structural assembly is subjected to tensile force of 1kN along its axis and a shear force of 0.5 kN. The diameter of the bolt is 12 mm. Determine the state of stress at a point and maximum stress induced in the bolt according to maximum shear stress theory? (6)

PART B

Answer any two full questions, each carries 15 marks.

4 a) Explain the failure modes of a riveted joint? (5)

b) A bolted assembly is held in place by 10 bolts. Each bolt is tightened to an initial tension of 5000 N. The external force acting on the assembly is 20 kN. Total bolt stiffness is one fourth of total joint stiffness. Find the size of the bolt if the permissible tensile stress is 100 MPa. (10)

5 Design a socket and spigot type cotter joint to connect two rods to carry a load of 120 kN. The rods are made of steel SAE 1045 and assume factor of safety as 4 for tension, 4 for shear and 3 for crushing. (15)

6 a) Explain the effect of initial tension of bolts. (6)

b) A steel plate of 15 mm thickness is welded to another plate by two longitudinal fillet welds (one side) to carry a tensile load of 50 kN. Assume shear stress 80 MPa. Determine the length of the weld required for static and dynamic load. (9)

PART C

Answer any two full questions, each carries 20 marks.

7 a) List the properties of a spring material? (5)

b) Explain the term "surging" in springs. Elaborate the methods to overcome it? (5)

c) A carriage weighing 40kN is moving with linear velocity of 10 km/hr. It is stopped by 4 numbers of buffer springs in which the maximum compression allowed is 20 cm. The springs have mean diameter of 15 cm, diameter of the spring wire is 2.5 cm and modulus rigidity of the material is $82.7 \times 10^3 MPa$. Find the number of active turns in each spring. Assume square and grounded ends. (10)

8 a) What are the difference between rigid and flexible coupling? (5)

b) What are the different types of transmission shaft? (5)

c) A hollow shaft transmits 210 kW at 200 rpm. The total angle of twist in a length of 5 m is 3^0. Find the inner and outer diameters of the shaft, if the shear stress is limited to 68 MPa. Take $G = 78 \times 10^3$ MPa . (10)

9 a) Prove that compressive stress induced in square key is twice that of shear stress (5)

b) Design a CI flange coupling to transmit 20 kW at 1500 rpm. The allowable stresses for shaft, keys and bolts are 78 MPa in shear and 160 MPa in crushing. The allowable shear stress for CI flange is 5 MPa. (15)

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