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Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech S7 (S) Examination Sept 2020

Course Code: ME401

Course Name: DESIGN OF MACHINE ELEMENTS - I

Max. Marks: 100 Duration: 3 Hours

(i) Use of approved design data book is permitted

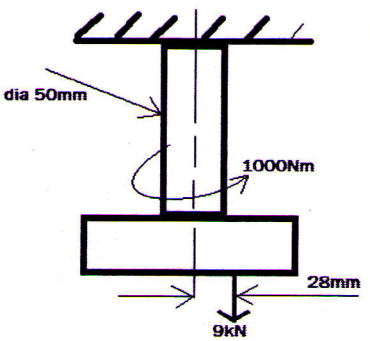
(ii) Missing data if any may be suitably assumed

PART A

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

1 a) Draw the engineering stress-strain diagram of mild steel and explain the salient points on it. (5)

b) A load of 9 kN is applied to the steel rod of 50 mm diameter as shown in Figure. If a torsional moment of 100 N-m is applied on it, Determine the maximum tensile stress and maximum shear stress. (10)



2 a) What is factor of safety? What are the factors to be considered in the selection of factor of safety (FoS)? (3)

b) What is notch sensitivity factor and explain its significance in the design under dynamic loading. (3)

c) State and explain the theories of failure (a) Rankine theory (b) von Mises theory and (c) Maximum shear stress theory. Plot the region of safety for each theory. (9)

3 a) Explain Soderberg, Goodman and Gerber's criteria for design under fatigue loading. (6)

b) A steel shaft subjected to a torque that varies over a range of ±40%. Determine the diameter of the shaft if it transmits 15 kW at 250 rpm. The material has an ultimate strength of 600 MPa and yield strength of 400 MPa. Take FoS 3. (9)

PART B

Answer any two full questions, each carries 15 marks.

4 a) What is the difference between lead and pitch? Write the relation connecting them. (2)

b) Explain the stresses acting on a Screw fastener. (6)

c) A cylinder head is fastened to the cylinder of a compressor using 6 bolts of M20 size. Bolt material is C20 steel. The maximum fluid pressure is 3.5 MPa, and the cylinder diameter is 75 mm. A soft gasket is used. Assume the initial tension required in each bolt as 40 kN. Determine the factor of safety. (7)

5 a) What do you mean by the efficiency of a power screw? How do you find the efficiency of a self-locking screw? (4)

b) What are the different types of threads used in power screw? (2)

c) The square thread of a screw jack 80 x 72 x 16 (*in mm*), with a double start is to raise a load of 100 kN. The mean collar diameter is 130 mm. The coefficient of friction for the threads and the collar are 0.1 and 0.2 respectively. Determine (9)

a. The torque required to raise the load.

b. The efficiency of the screw.

c. Whether self-locking exists?

6 a) Explain the failures modes of riveted joints and how will you determine the efficiency of a rivet joint? (5)

b) Design a double riveted butt joint with equal widths of cover plates to join two (10)

plates of thickness 10 mm. The allowable stress for the material of the rivets and for the plates are as follows: for plate material in tension σ_t = 80 MPa, for rivet material in compression, σ_c=120 MPa, for rivet material in shear,τ = 60 MPa.

PART C

Answer any two full questions, each carries 20 marks.

7 a) What is nipping in leaf springs? (2)

b) Why the leaf springs are laminated? (3)

c) A carriage weighing 25 kN is moving on a drag with linear velocity 3.6 km/hr. It is brought to rest by two helical compression springs in the form of a damper by undergoing compression of 180 mm. The spring may be assumed to have a spring index of 6 and permissible shear strength of 450 MPa. Design the spring. (Take G = 80 GPa). (15)

8 a) What are the different types of keys? *(any four)*; and explain its failure modes. (5)

b) Design a flanged coupling to transmit a power of 25 kW at a rated speed of 500 rpm. (15)

9 a) Compare the strength and stiffness of a hollow shaft to that of a solid shaft if both are having same outside diameter (5)

b) A shaft is supported by bearings 600 mm apart. It carries a pulley of diameter 500 mm; at 250 mm to the right of left bearing and another pulley of diameter 380 mm; at 130 mm to the right of the right bearing. The belt drive in the left pulley is vertically downward while that on the right pulley is horizontal. The permissible shear stress is not to exceed 42 MPa. The maximum tension in the smaller pulley is not to exceed 5.5 kN. Find the diameter of the shaft. (Coefficient of friction is 0.3 and angle of contact is 180^0). (15)