Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Seventh Semester B.Tech Degree (S, FE) Examination January 2023 (2015 Scheme)

Course Code: ME401

Course Name: DESIGN OF MACHINE ELEMENTS - I

Max. Marks: 100 Duration: 3 Hours

Use of Design data book is permitted

PART A

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

1 a) Explain the steps involved in design process. (4)

b) Sketch engineering stress strain and true stress strain diagrams for a ductile material. Describe the salient features of the curves. (5)

c) Differentiate between finite and infinite life problems in the design of a machine component subjected to fatigue loading? Brief the steps involved in it. (6)

2 a) Define stress concentration. What are the ways to mitigate it? (5)

b) A plate of uniform thickness't' has two widths of 45 mm and 30 mm with a fillet radius of 5 mm. The smaller width portion has a transverse hole of 15 mm diameter. For the plate material the ultimate tensile strength is 200 N/mm^2. Considering stress concentration effect and assuming a factor of safety of 2.5, find the thickness of plate for a maximum tensile load of 5 kN. (10)

3 a) Differentiate between endurance limit and fatigue strength of a material. (4)

b) Find the diameter of a shaft to transmit twisting moments varying from 500 N-m to 2000 N-m. The ultimate tensile strength is 600 N/mm^2, yield stress is 450 N/mm^2. Assume stress concentration factor as 1.2, surface finish factor as 0.8, size factor as 0.85 and factor of safety as 2. Refer Fig.1 as shown below. (11)

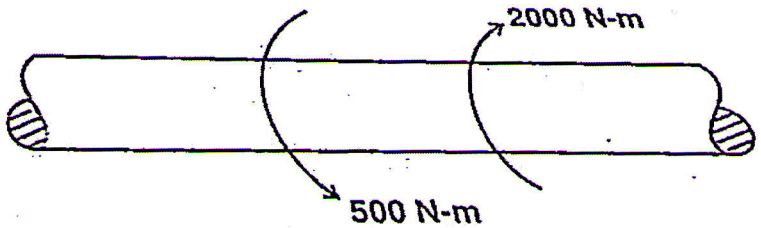


Fig.1

PART B

Answer any two full questions, each carries 15 marks.

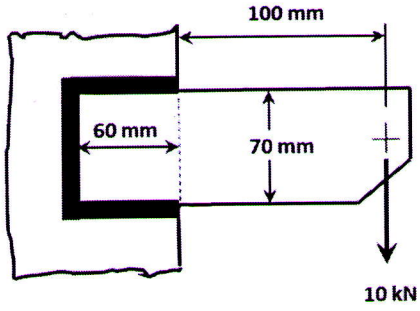
4 a) Define nominal diameter, pitch, lead and thread angle of a thread. (4)

b) In what way coarse thread is differed from fine thread? (2)

c) The cylinder head of a steam engine which is held in position by means of 12 bolts, subjected to a steam pressure of 5bar. The joint is made leak proof by using a soft copper gasket. If the effective diameter of cylinder is 250 mm, find the size of bolts. Assume that allowable tensile stress for the bolt is limited to 90 N/mm^2. (9)

5 a) Classify welded joints with simple sketches. (3)

b) Determine the size of weld required for the joint shown in figure below. Take allowable stress of the weld material as 80 N/mm^2. (12)



6 a) Discuss the failure modes of riveted joints and define its efficiency. (4)

b) Two plates of 9 mm thick are to be joined by a triple riveted, zig-zag, lap joint. Design the joint using the allowable stresses as 80MPa for plates in tension; 60 MPa for rivets in shear; 100 MPa for rivets in crushing. Find the efficiency of the joint. Also sketch the final joint, Given that pitch p=95 mm; diameter of rivet hole d_o= 19 mm; back pitch p_b= 40 mm. (11)

PART C

Answer any two full questions, each carries 20 marks.

7 a) Define A M Wahl's factor and state its importance in design of springs. (5)

b) A helical compression spring is subjected to a varying load between 500 N to 1200 N. The spring index is 6 and a factor of safety of 1.5 is desired. The yield stress in shear is 760 MPa and endurance limit in shear is 350 MPa. Calculate (15)

(a) Diameter of spring wire.

(b) Mean coil diameter.

(c) Number of active coils.

(d) Free length of spring.

The compression of spring at the maximum load is 25 mm and modulus of rigidity is 82 kN/mm^2.

8 a) Explain the design of a shaft based on torsional stiffness. (5)

b) A hollow steel shaft is to be transmitted 30 kW at 300 rpm with 20% overload. The maximum bending moment in the shaft is 1500 N-m and axial compressive load is 10 kN. The shaft is supported on rigid bearings 2 m apart. The permissible shear stress in the shaft is 42 MPa and the diameter ratio is 0.6. The shock and fatigue factors in bending and torsion are 1.6 and 1.5 respectively. Determine the diameter of the shaft. (15)

9 a) What is critical speed of a shaft? (3)

b) Explain shock and fatigue factor in shaft design. (3)

c) A rigid flange coupling is to be designed to transmit 20 kW at 1000 rpm. Assuming suitable allowable stresses, design the coupling. (14)

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