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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Seventh Semester B.Tech Degree Supplementary Examination June 2022 (2015 Scheme)

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) Distinguish the behaviour of ductile and brittle materials with the help of stress versus strain diagram. Also mark the salient features of the curves. (4)

b) Differentiate between codes and standards (3)

c) Define stress concentration. How to mitigate it? (3)

d) Explain the difference between finite and infinite life problems in the design of a machine component subjected to fatigue loading? Brief the steps involved in it. (5)

2 a) Define endurance limit of a material. What are the factors affecting it? (5)

b) A tie bar has to carry a load of 100 kN. What must be the thickness of a bar of 110 mm width, if there is a rivet hole of 22 mm diameter on its centre line? Assume the working stress for the material of tie bar as 75 MPa. (10)

3 a) Define notch sensitivity factor. Obtain an equation for it. (3)

b) Find the diameter of a steel shaft to transmit twisting moments varying from 500 N-m to 2000 N-m as shown in Fig. 1. The ultimate tensile strength of the material is 600 N/mm^2 and 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. (12)

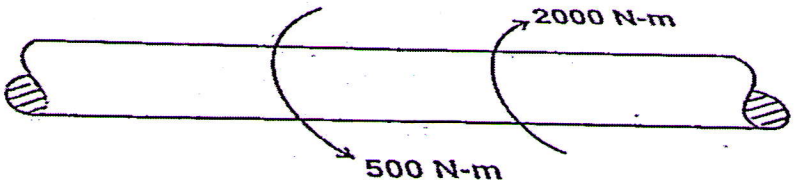

Fig.1

PART B

Answer any two full questions, each carries 15 marks.

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

b) The double threaded screw of a screw jack has the following specifications. (11)

Load to be raised : 100 kN, Outer diameter of square thread : 75 mm,

Mean collar diameter: 125 mm, Pitch : 16 mm, Coefficient of friction for thread : 0.1, Coefficient of friction for collar : 0.12.

Determine the torque required to operate the screw jack and the efficiency of the screw.

5 a) What are cotter and knuckle joints? State briefly the situations in which they are used in engineering practice. (4)

b) Two plates of 9 mm thick are to be joined by a triple riveted, zig-zag, lap joint. (11)

The allowable stresses are given as, 80 MPa for plates in tension, 60 MPa for rivets in shear and 100 MPa for rivets in crushing.

Design the joint and find the efficiency. Also sketch the joint.

6 Determine the size of weld required for the joint shown in Fig. 2. Take allowable stress of the weld material as 80 N/mm^2. (15)

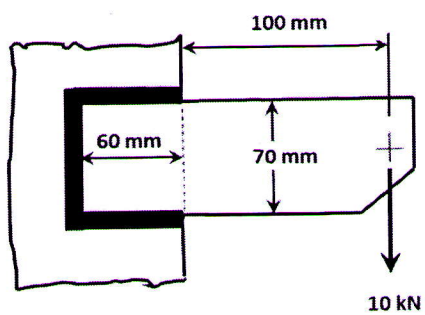

Fig. 2

PART C

Answer any two full questions, each carries 20 marks.

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

b) Design a close-coiled helical compression spring to sustain a load ranging from 250 N to 300 N. The axial deflection of the spring is limited to 8 mm. Assume a spring index of 8. The permissible shear stress in the spring wire is 420 MPa and modulus of rigidity is 84 GPa. (15)

8 a) Distinguish between shaft, axle and spindle from the design point of view. (5)

b) A shaft of length 380 mm carries a spur gear of 20^0 involute teeth of 300 mm (15)

diameter at the midpoint and transmits 22.5 kW at 300 rpm. Using factor of safety = 1.5, yield strength = 350 MPa, Find the diameter of the shaft considering both tangential and radial components of gear tooth load. The shaft is running under moderate shock load.

9 a) Indicate what type of coupling is used under the following conditions (6)

(i) With shafts having collinear axes.

(ii) Shafts having intersecting axes

(iii)Shafts having parallel axes with a small distance apart.

b) Design a flexible coupling of bush type to transmit 3 kW power at 960 rpm with a service factor of 1.2. Assume design stresses as (14)

For shaft, bolt and key in shear = 50 N/mm^2

For coupling in shear = 20 N/mm^2

For bushes in bearing = 2 N/mm^2

For key in crushing = 100 N/mm^2

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