

Reg No.: _____

Name: _____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
SEVENTH SEMESTER B.TECH DEGREE EXAMINATION, DECEMBER 2018

Course Code: ME401
Course Name: DESIGN OF MACHINE ELEMENTS - I

Max. Marks: 100

Duration: 3 Hours

Use of approved design data book is permitted

PART A

Answer any two full questions, each carries 15 marks.

Marks

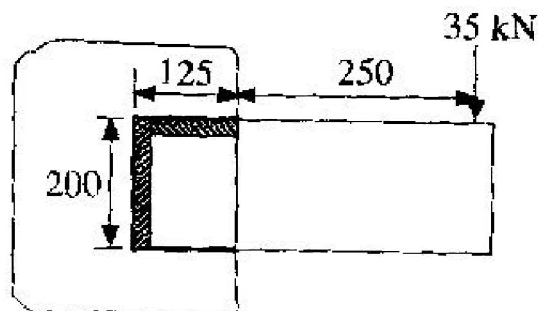
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|---|--|------|
| 1 | a) Distinguish between standards and codes | (2) |
| | b) Explain notch sensitivity factor, q. What is the relationship between fatigue stress concentration factor and q. | (2) |
| | c) Explain the procedure to determine the endurance limit of a material. Also plot the SN curve for steel and aluminium. | (5) |
| | d) Draw the stress- strain behaviour of the following materials
i) Ductile ii) brittle and iii) perfectly elastic-plastic | (6) |
| 2 | a) Explain maximum principal stress theory and max shear stress theory of failure. | (2) |
| | b) The stresses acting at a critical point in a component are $\sigma_{xx}=60\text{MPa}$, $\sigma_{xy}=30\text{MPa}$, $\sigma_{xz}=20\text{MPa}$, $\sigma_{yy}=40\text{MPa}$, $\sigma_{zz}=25\text{MPa}$ and $\sigma_{yz}=20\text{MPa}$. The component is made of steel having the following material properties. Ultimate strength in tension, $\sigma_u=600\text{MPa}$, yield strength in tension, $\sigma_y= 400 \text{ MPa}$, yield strength in shear, $\tau_y= 200 \text{ MPa}$ and poisson's ratio, $\mu =0.3$. Determine the factor of safety using all the five static failure theories. | (13) |
| 3 | a) What is fatigue stress concentration factor? | (2) |
| | b) A smooth cantilever beam of circular cross section made of hot rolled steel is subjected to an axial load which varies from 7 k N in tension to 5 k N in compression. It is also subjected to a transverse load at the free end which varies from +8 k N to - 6 k N. The length of the cantilever is 400 mm. The material properties are $\sigma_u=500 \text{ MPa}$, $\sigma_y= 300 \text{ MPa}$. Factor of safety may be taken as 2. Find the diameter of the beam for a reliability of 90 %. | (13) |

PART B

Answer any two full questions, each carries 15 marks.

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|---|---|-----|
| 4 | a) What are the failure modes of a riveted joint? | (2) |
| | b) Explain thread loosening. What are the factors influencing thread loosening? | (3) |

- c) Distinguish between self-locking and overhauling. (2)
- d) The lead screw of a lathe has 50×8 threads. The screw must exert an axial force of 4 kN in order to drive the tool carriage. The thrust is carried on a collar 120 mm outside diameter and 60 mm inside diameter. The screw rotates at 40 r.p.m. The coefficient of friction for the screw and collar is 0.15 and 0.12 respectively. Determine the power required to drive the screw and the efficiency of the lead screw. (8)
- 5 a) What is initial tension in a bolted joint? Why is it necessary? (2)
- b) What is the role of washer in a bolted joint? (2)
- c) A cylinder head is held on the cylinder by 8 numbers of bolts. The inner diameter of the cylinder is 350 mm. The pressure inside the cylinder varies from zero to a maximum pressure of 2.5 MPa. The ultimate tensile stress and yield stress are 630 MPa and 380 MPa respectively. The bolts are tightened with initial preload of 1.5 times the steam load. A copper asbestos gasket is used to make the joint leak proof. Take factor of safety is 2.5. Neglect stress concentration factor. Find the size of the bolt. (11)
- 6 a) What are the demerits of welded joints? (2)
- b) What is weld reinforcement? Why is it done? (2)
- c) An eccentrically loaded weld joint is shown in figure. Find the size of the weld if the allowable shear strength is 80 MPa. All the lengths given in the figure are in mm. (11)



PART C

Answer any two full questions, each carries 20 marks.

- 7 a) What are the requirements of spring material? (2)
- b) What is nipping in leaf springs? Explain its purpose (3)

- c) Design a truck spring that has 12 numbers of leaves, two of which are full length leaves. The spring supports are 1 meter apart and the central band is 70 mm wide. The central load is to be 6 kN with a permissible stress of 200 MPa. Determine the thickness, width, leaf lengths and deflection of the spring leaves if the ratio of total depth to width of the spring is 3. (15)
- 8 a) Compare the strength and stiffness of a hollow shaft of same outside diameter as that of a solid shaft. (5)
- b) A shaft is supported by two bearings 1 m apart. A 600 mm diameter pulley is mounted at a distance of 300 mm to the right of left hand bearing and this drives a pulley directly below it with the help of a belt having maximum tension of 2.25 kN. Another pulley 400 mm diameter is placed 200 mm to the left of right hand bearing and is driven with the help of electric motor and belt, which is placed horizontally to the right. The angle of contact for both the pulley is 180° and $\mu=0.24$. Determine the suitable diameter for a solid shaft .The allowable working stress is 63 MPa in tension and 42 MPa in shear for the material of the shaft. Assume that the torque on one pulley is equal to that on the other pulley. (15)
- 9 a) Prove that a square key is equally strong in crushing and shearing. (5)
- b) Design a bushed-pin type flexible coupling to connect a pump shaft to a motor shaft transmitting 32 kW at 960 rpm. The overall torque is 20% more than mean torque. Material properties are as follows: (15)
1. The allowable shear and crushing stress for shaft and key material is 40 MPa and 80 MPa respectively.
 2. The allowable shear stress for cast iron is 15 MPa.
 3. The allowable bearing pressure for rubber bush is 0.8 MPa.

The material of the pin is same as that of shaft and key
