4E4143

B. Tech. IV-Sem. (Main) Exam; April-May 2017
Production & Industrial Engg.
4PI4A Design of Machines Elements - I

Time : 3 Hours

Maximum Marks : 80

Min. Passing Marks : 24

Instructions to Candidates :-

Attempt any five questions, selecting one question from each unit. All Questions carry equal marks. Schematic diagrams must be shown wherever necessary. Any data you feel missing suitably be assumed and stated clearly.

Units of quantities used / calculated must be stated clearly.

Use of following supporting materials is permitted during examination. (Mentioned in form No. 205)

1. NIL _____   2. NIL _____

UNIT - I

1 (a) What is a machine element ? Give two examples.

4

(b) What do you understand by mechanical properties of materials ? How these are helpful in machine design ?

12

OR

1 (a) What is 'machine design' ? Explain the basic procedure of machine design.

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(b) Explain standardization, limits, fits and surface roughness for manufacturing consideration in design with neat sketch and suitable examples.

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UNIT - II

2 (a) What is 'Stress concentration' ? How it can be reduced in a component ?

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(b) Determine the diameter of a circular rod made of ductile material with a fatigue strength (complete stress reversal) σ_c = 265 MPa and a tensile yield strength of 350 MPa. The member is subjected to a variable axial load from W_{min} = – 300×10^3 N to W_{max} = 700×10^3 N and has a stress concentration factor = 1.8. Use factor of safety as 2.0.

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OR

2 It is required to design a cotter joint to connect two steel rods of equal diameters. Each rod is subjected to an axial tensile force of 50 kN. Design the joint and specify its main dimensions.

16

UNIT - III

3 (a) What is a 'beam' ? Which type of stresses can be induced in it ? Discuss the role of section modulus in beams design with two examples of different shapes.

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(b) A truck spring has 12 number of leaves, two of which are full length leaves. The spring supports are 1.05 m and the central band is 85 mm wide. The central load is to be 5.4 kN with a permissible stress of 280 MPa. Determine the thickness and width of the steel spring leaves. The ratio of the total depth to the width of the spring is 3. Also determine the deflection of the spring.

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OR

3 (a) What is a 'lever' ? Explain the principle of it and leverage. Classify the levers.

8

(b) A right angled bell-crank lever is to designed to raise a load of 5 kN at the short arm end. The lengths of short and long arms are 100 and 450 mm respectively. The lever and the pins are made of steel 30C8 (S_{yt} = 400 N/mm²) and the factor of safety is 5. The permissible bearing pressure on the pin is 10 N/mm². The lever has rectangular cross-section and the ratio of width to thickness is 3 : 1. The length to diameter ratio of fulcrum pin is 1.25 : 1

Calculate :

(i) The diameter and the length of fulcrum pin
(ii) The shear stress in the pin
(iii) The dimensions of the boss of the lever of the fulcrum and
(iv) The dimensions of the cross-section of the lever.

Assume that the arm of bending moment on the lever expands upto the axis of the fulcrum.

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UNIT - IV

4 (a) A line shaft transmits 25 kW power at 200 rpm by means of a vertical belt drive. The diameter of the belt pulley is 1 m and the pulley overhangs 150 mm beyond the centre line of the end bearing. The belt tension acts vertically downward. The tension on the tight side of the belt is 2.5 times that on slack side. The shaft is made of plain carbon steel 40C8 (S_{yt} = 380 N/mm²) and the factor of safety is 2.5. The mass of the pulley is 25 kg. Determine the diameter of the shaft.

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(b) What is a 'key' ? Explain the failure of key.

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OR

4 (a) What is coupling ? Classify it.

4

(b) Design a muff coupling which is used to connect two steel shafts transmitting 25 kW power at 360 rpm. The shafts and key are made of plain carbon steel 30C8 (S_{yt} = S_{yc} = 400 N/mm²). The sleeve is made of grey cast iron FG 200 (S_{ut} = 200 N/mm²). The factor of safety for the shaft and key is 4. For the sleeve, the factor of safety is 6 based on ultimate strength.

12

UNIT - V

5 (a) Explain the concept of thread for single start and double start, relative to lead of them. Explain the terminologies used to define the threads with neat sketches.

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(b) What are the 'locking devices' ? Classify them and explain their working concept with neat sketches.

8

OR

5 (a) Why uniform strength is required in bolts ? How it can be achieved ? Determine the diameter of the hole that must be drilled in a M48 belt such that the bolt becomes of uniform strength.

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(b) A bracket, as shown in Fig. supports a load of 30 kN. Determine the size of bolts, if the maximum allowable tensile stress is in the bolt material is 60 MPa. the distances are L_1 = 80 mm, L_2 = 250 mm and L = 500 mm.
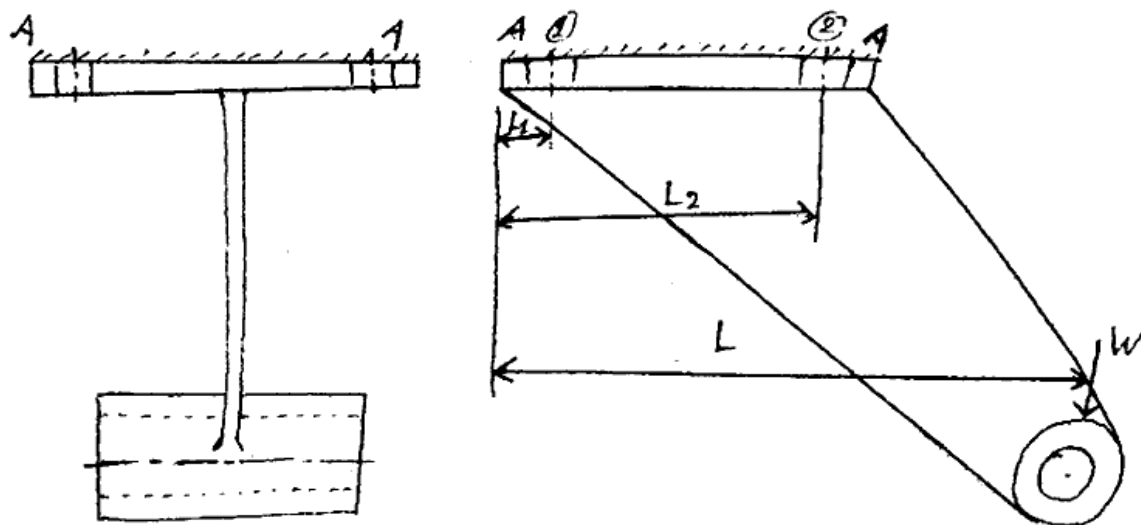
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Fig. : Bracket with eccentric loading.