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10AU52

Fifth Semester B.E. Degree Examination, Dec.2018/Jan.2019
Design of Machine Elements – I

Time: 3 hrs. Max. Marks:100

Note: 1. ***Answer FIVE full questions, selecting at least TWO questions from each part.***
2. ***Use of design data hand book is permitted.***

PART – A

1 a. Explain briefly the important characteristics used in design considerations. **(10 Marks)**

b. Define standardization. State the standards used in machine design. **(05 Marks)**

c. A beam of uniform rectangular cross section is fixed at one end and carries a load 1000 N at a distance of 300 mm from the fixed end. The maximum bending stress in the beam is 80 N/mm^2. Find the width and depth of beam, if depth is twice that of width. **(05 Marks)**

2 a. Explain the following theories of failure:
(i) Maximum normal stress theory. (ii) Maximum shear stress theory.
(iii) Distortion energy theory **(06 Marks)**

b. Explain briefly the following impact strength:
(i) Impact stresses due to bending.
(ii) Impact stresses due to torsional loads **(04 Marks)**

c. A grooved shaft shown in Fig. Q2 (c) is to transmit 5 kW at 120 rpm. Determine the diameter of the shaft at the groove, if it is made of C15 steel $(\sigma_y = 235.4\ \text{MPa})$. Factor of safety is 2. **(10 Marks)**

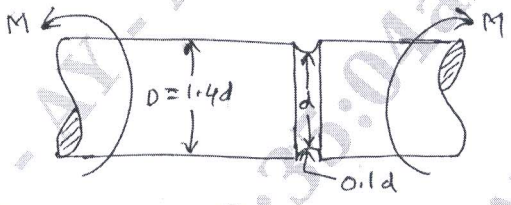

Fig. Q2 (c)

3 a. Define endurance limit. List the factors affecting endurance limit. **(04 Marks)**

b. Derive the Soderberg equation in the following form where A is load factor, B is size factor and C is the surface finish factor.

$$\frac{1}{N} = \frac{\sigma_m}{\sigma_y} + \frac{K_{tf}\sigma_a}{A.B.C.\sigma_{en}}$$ **(06 Marks)**

c. A piston rod is subjected to a maximum reversed axial load of 110 KN. It is made of steel having an ultimate stress of 900 N/mm^2 and the surface is machined. The average endurance limit is 50% of the ultimate strength. Take the size correction coefficient as 0.85 and FOS = 1.75. Determine the diameter of the rod. **(10 Marks)**

4 a. A 19 KW, 1440 rpm motor has a steel shaft. The extension of the shaft is 75 mm. Diameter of the shaft is 45 mm. The motor pullout torque is 3.5 time the average full load torque of the motor. Assuming an yield shear stress of 54 MPa and crushing stress of 108 MPa for a key material, design the key. Also determine the effect of keyways. Adopt a FOS as 2.5. Assume taper key. **(10 Marks)**

b. A bush pin type flexible coupling has four pins of size M16, made of steel having allowable shear stress of 60 MPa. The outside diameter and length of rubber bush on the pin are 38 mm and 45 mm respectively. The pins are located on a pitch circle of diameter 200 mm. The allowable bearing pressure in the rubber bush is 1.0 MPa. If the coupling rotates at 900 rpm, calculate the power that can be transmitted. Check whether the size of pin is acceptable for the power transmitted. **(10 Marks)**

PART – B

5 a. Compare the weight-strength and stiffness of a hallow shaft of the same external diameter as that of a solid shaft. The inside diameter of the hallow shaft being half the external diameter. Both shafts have the same material of length. **(10 Marks)**

b. A shaft is mounted between bearings located 9.5 meter apart and transmits 10,000 KW at 90 rpm. The shaft weighs 66,000 N, has outside diameter = 450 mm and inner diameter is 300 mm. Determine the stress induced in the shaft and the angular deflection between the bearings. Assume steady load. Do not neglect the weight of shaft. Take G = 80 GPa. **(10 Marks)**

6 a. Explain briefly stresses in screw fastening due to static loading. **(10 Marks)**

b. Determine the safe tensile load for bolts of M20 and M30. Assume the bolts are not initially stressed and take the permissible tensile stress as 200 N/mm^2. **(05 Marks)**

c. A bolt in a steel structure is subjected to a tensile load of 9 KN. The initial tightening load on the bolt is 5 KN. Determine the size of bolt taking allowable stress for the bolt material to be 80 MPa and K = 0.05. **(05 Marks)**

7 a. Explain the various possible modes of failure of a riveted joint. **(05 Marks)**

b. Design a double riveted butt joint with two cover plates for the longitudinal seam of a boiler shell 1.5 m in diameter subjected to a steam pressure of 0.95 N/mm^2. Assume as efficiency of 75% allowable tensile stress in the plate of 90 N/mm^2, allowable crushing stress of 140 N/mm^2 and an allowable shear stress in the rivet of 56 N/mm^2. Assume equal width cover plates with chain type riveting. **(15 Marks)**

8 a. A welded connection of steel plates as shown in Fig. Q8 (a) is subjected to an eccentric load of 10 KN, determine the throat dimension of weld, if the permissible stress is limited to 95 N/mm^2. Assume static conditions. **(10 Marks)**

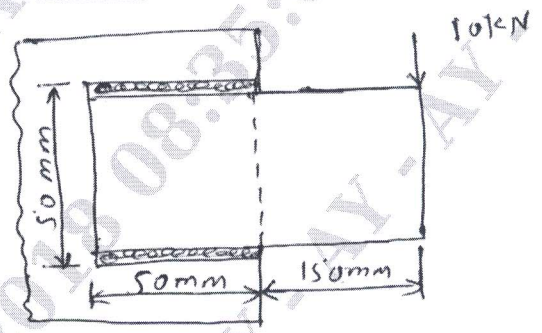

Fig. Q8 (a).

b. A triple-threaded power screw is used in a screw jack, has a nominal diameter of 50 mm and a pitch of 8 mm. The threads are square shape of the length of the nut is 48 mm. The screw jack is used to lift a load of 7.5 KN. The coefficient of friction at the threads is 0.12 and the color friction is negligible. Calculate

(i) Principal shear stress in the screw rod.
(ii) Transverse shear stress in the screw and nuts.
(iii) Unit bearing pressure for threads. **(10 Marks)**

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