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06ME52

Fifth Semester B.E. Degree Examination, Dec.2013/Jan.2014
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.***
3. ***Assume the missing suitably data.***

PART – A

1 a. Write brief note on general procedure used in design. **(05 Marks)**

b. Discuss factors influencing the selection of a suitable material for a machine element. **(10 Marks)**

c. Explain the codes and standards used in machine design. **(05 Marks)**

2 a. What is stress concentration? What are the factors affecting the stress concentration? Explain. **(05 Marks)**

b. A Cantilever beam is loaded as shown in the Fig. Q2 (b). Determine the value of 'd' limiting the maximum normal stress induced to 120 MPa. Analyze at the change of cross section only. **(05 Marks)**

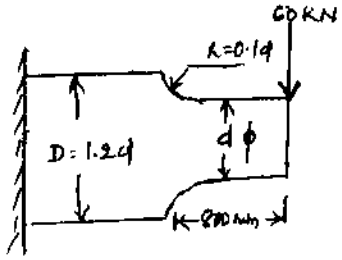


Fig. Q2 (b)

c. A mild steel shaft is subjected to 3500 N-m of bending moment at its critical point and transmits a torque of 2500 N-m. The shaft is made of steel having yield strength of 231 N/mm^2. Estimate the size of the shaft based on various theories of failure with factor of safety of 2 and specify the final size. **(10 Marks)**

3 a. Derive the Soderberg's equation.

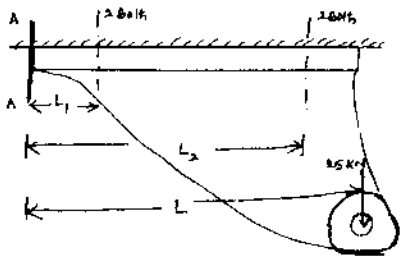
$$K_{fi}\frac{\sigma_a}{ABC\sigma_{en}}+\frac{\sigma_m}{\sigma_y}=\frac{1}{N}$$

Where K_{fi} is effect of stress concentration
A is the load factor
B is the size factor
and C is the surface finish factor **(06 Marks)**

b. A shaft supported by bearings 400 mm apart is subjected to a concentrated load varying from "W" to "3W" at its mid point. The shaft is of 50 mm diameter. Estimate the value of "W" with a factor of safety of 1.5. The material has an ultimate strength of 700 N/mm^2, endurance limit of 350 N/mm^2 and yield strength of 525 N/mm^2. Take size factor of 0.85 and a surface finish factor of 0.848. **(14 Marks)**

4 a. Explain various types of stresses in threaded fasteners. **(06 Marks)**

4 b. A bracket is connected by bolts are shown in Fig. Q4 (b). If the permissible tensile stress for the bolt material is 60 N/mm^2. Specify the size of the bolt. The bracket is fixed using 4 bolts. **(14 Marks)**



L_1 = 75 mm
L_2 = 225 mm
L = 500 mm

Fig. Q4 (b)

PART – B

5 A power transmission shaft is supported in bearings 2 m apart and carries a pulley weighing 1 kN at its mid point and it receives power by a belt drive. The shaft transmits power to another machinery by means of flexible coupling just outside the right bearing. The power transmitted is 20 kW at 120 rpm. The ratio of belt tensions is 3 : 1. Estimate the size of the shaft if the permissible stress in shear is 54 N/mm^2. Also calculate the twist in the shaft if $G = 0.8\times10^5$ N/mm^2. Take C_m and C_t as 1.5 and the pulley dia is 200 mm. **(20 Marks)**

6 a. Design a Knuckle joint suitable for connecting two rods subjected to axial force of 12 kN. The permissible stresses are 40 N/mm^2 in tension, 80 N/mm^2 in compression and 32 N/mm^2 in shear. Give a neat dimensioned sketch. **(10 Marks)**

b. Design a flexible bushed pin type coupling suitable for transmitting 40 kW of power at 1000 rpm. The overall torque is 20 percent greater than the mean torque. The material properties are as follows:

i) The allowable shear and crushing stress for shaft and key material is 40 N/mm^2 and 120 N/mm^2 respectively.
ii) The allowable shear stress for cast iron is 10 N/mm^2.
iii) The allowable bearing pressure for rubber bush is 0.45 N/mm^2.
iv) The material of the pin is same as that of shaft and key having allowable stress in bending of 152 N/mm^2.

Motor shaft diameter is 50 mm and pump shaft diameter is 45 mm. **(10 Marks)**

7 a. Design a double riveted butt joint with two cover plates for longitudinal beam of a boiler shell 1.5 m in diameter subjected to steam pressure of 0.95 N/mm^2. Assume joint efficiency as 75%, allowable tensile stress is 90 N/mm^2, compressive stress is 140 N/mm^2 and shear stress is 56 N/mm^2. **(10 Marks)**

b. A bracket is welded to a side column as shown in Fig. Q7 (b) with a permissible stress of 80 N/mm^2. Determine the maximum load that the bracket can withstand if the size of the weld is 10 mm. **(10 Marks)**

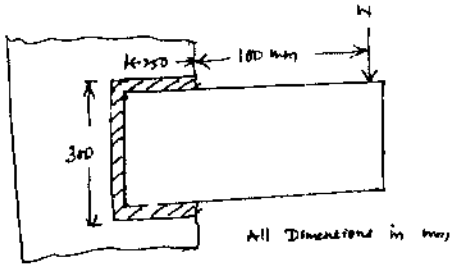


Fig. Q7 (b)

8 a. Explain self locking and overhauling in power screws. **(05 Marks)**

b. The cutter of a broaching machine is pulled by a square threaded screw 55 mm outer diameter having 10 mm pitch. The operating nut takes an axial load of 400 N on a flat surface 60 mm inner diameter and 90 mm outer diameter. If μ at threads and collar is 0.15. Find: i) The torque on the screw.
ii) The power required for the motor at a cutting speed of 6 m/min.
iii) Efficiency of the screw. **(15 Marks)**

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