CBCS SCHEME

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15MT51

Fifth Semester B.E. Degree Examination, Dec.2023/Jan.2024
Design of Machine Elements

Time: 3 hrs. Max. Marks: 80

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

Module-1

1 a. Define stress concentration factor and explain the stress concentration phenomenon. **(02 Marks)**

b. A bar of rectangular section as shown in Fig.Q1(b) is subjected to an axial pull of 500 kN. Calculate its thickness if the allowable stress in the bar material is 200 MPa.

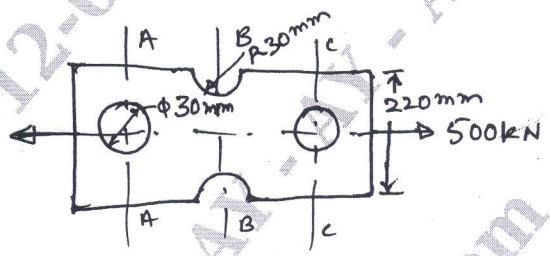

Fig.Q1(b) **(10 Marks)**

c. Determine the maximum stress induced in a stepped shaft with a maximum dia of 50 mm and a minimum dia of 25 mm, fillet radius is 5 mm, subjected to tensile load of 12 kN. **(04 Marks)**

OR

2 a. Explain the following theories of failure:
i) Maximum normal stress theory
ii) Maximum shear stress theory. **(08 Marks)**

b. The stress at a point in a body are $\sigma_x = 91$ MPa, $\sigma_y = 21$ MPa, $\tau_{xy} = 84$ MPa, $\sigma_{yt} = 280$ MPa, find the FOS. By:
i) Maximum principal stress theory
ii) Maximum shear stress theory **(08 Marks)**

Module-2

3 Design Flange coupling for the following specification P = 20 KW, speed = 1440 rpm. Draw assembled sketch. Design following parts:
i) Design of shaft
ii) Design of hub
iii) Design of key
iv) Design of bolts **(16 Marks)**

OR

4 Design screw jack for the following specification, capacity 40 kN, maximum lift = 200 mm, following parts to be designed:
i) Screw spindle with head
ii) Design of nut
iii) Design of handle.
Draw assembled view. Draw assembled sketch. **(16 Marks)**

Module-3

5 A horizontal piece commercial shafting is supported by two bearings 1.5 m apart. A keyed gear 20° involute and 175 mm in dia is located 400 mm to the left of the right bearing and is driven by a gear directly behind it. A 600 mm diameter pulley is keyed to the shaft 600 mm to the right of the left bearing and drives a pulley with a horizontal belt directly behind it. The tension ratio of the belt is 3 to 1, with the slack side on top. The drive transmit 45 KW at 330 rpm. Take Kb = Kt = 1.5. Calculate the necessary diameter of the shaft and angular deflection in degrees. Use allowable shear stress 40 MPa and $G = 80 \times 10^9$ N/mm^2. **(16 Marks)**

OR

6 a. What are the advantages and disadvantages of hollow shaft over solid shaft? **(06 Marks)**

b. In an axial flow rotary compressor the shaft is subjected to a maximum torque of 1500 N-m and a maximum bending moment of 3000 N-m. Neglecting the axial load on the compressor shaft, determine the diameter of compressor shaft. The sheer stress in the shaft material is limited to 50 N/mm^2, also design a hollow shaft for the above compressor taking inner diameter as 0.6 times the outer diameter. What percentage of material is saved in the hollow shaft? Assume minor shock condition. **(10 Marks)**

Module-4

7 Design a spur gear for following specification, power transmitted 20 KW, speed of pinion 1000 rpm. Determine the module. **(16 Marks)**

OR

8 Design a helical gear for following specification, power transmitted 40 KW, speed 1400 rpm. Determine module. **(16 Marks)**

Module-5

9 Design a main bearing of a steam turbine that runs at 1800 rpm, the load on bearing is estimated as 2500 N. **(16 Marks)**

OR

10 a. Derive an expression for the shear stress induced in a Helical compression spring, with usual notation. **(06 Marks)**

b. Design a helical compression spring to support an axial load of 3000 N. The deflection under load is limited to 60 mm. The spring index is 6. The spring is mode of Chrome-Vanadium steel and FOS is 2. **(10 Marks)**

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