CBCS SCHEME

USN

21ME63

Sixth Semester B.E. Degree Examination, June/July 2024
Machine Design

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. Use of data hand book is permitted.
3. Missing data if any may be suitably assumed.

Module-1

1 a. Explain the design procedure with the help of flow chart. **(06 Marks)**

b. Derive Soderberg's equation when a member is subjected to fatigue axial loading. **(06 Marks)**

c. A cantilever beam is C-45 steel is subjected to completely reversed bending load varying from 5F to –F as shown in Fig.Q1(c). Determine the maximum load the member can carry for infinite life. Take $\sigma_y = 353$ MPa and $\sigma_u = 640$ MPa for the material. Assume FoS = 2.

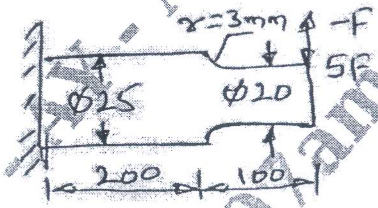

Fig.Q1(c) **(08 Marks)**

OR

2 a. Briefly discuss factors influencing the selection of suitable material for machine element. **(06 Marks)**

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

c. A bar of rectangular cross section is subjected to an axial pull of 500 kN as shown in Fig.Q2(c). Calculate its thickness if the allowable tensile stress in the bar is 200 MPa.

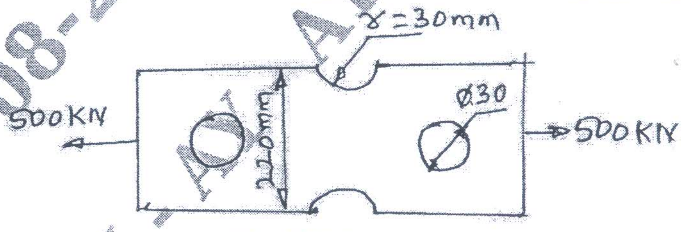

Fig.Q2(c) **(08 Marks)**

Module-2

3 A steel shaft 600 mm long supported between bearings carries a pulley of diameter 400 mm, weighing 400 N and is mounted in the middle of the shaft.

This shaft receives 40 KW at 600 rpm by a flat belt drive, power from the shaft is transmitted through another pulley of diameter 600 mm weighing 600 N overhanging the right bearing by 200 mm. The belt drives on the pulleys are at right angles to each other. Taking ratio of belt tensions as 3. Determine the diameter of the shaft required taking design shear stress as 40 MPa. **(20 Marks)**

OR

4 a. Derive an equation for shear stress due to twisting moment and deflection of helical spring. **(08 Marks)**

b. Design an helical spring for an operating load range from 90 N to 135 N. The deflection for this load range is 7.5 mm. Other data are as follows:
Spring index = 10
Permissible shear stress for the material = 480 MPa
Shear modulus = 80 GPa **(12 Marks)**

Module-3

5 a. Explain the following:
(i) Failure of riveted joints
(ii) Efficiency of riveted joint **(08 Marks)**

b. Determine the required fillet weld size for the bracket shown in Fig.Q5(b).

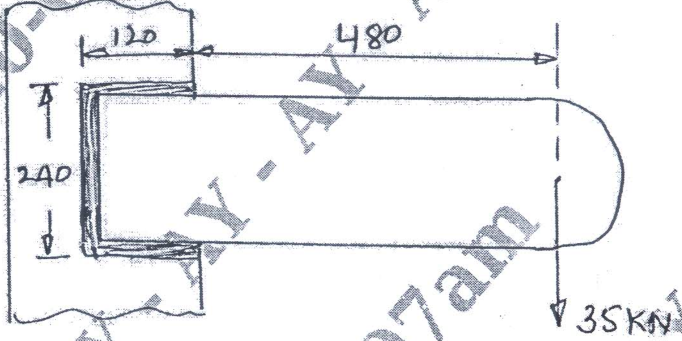

Fig.Q5(b) **(12 Marks)**

OR

6 a. Explain different types of stresses due to various loading on threaded fasteners. **(10 Marks)**

b. A cover plate is bolted on to the flanged end of a pressure vessel through 6 bolts. The inner diameter of the pressure vessel is 200 mm and is subjected to an internal pressure of 10 MPa. Selecting carbon steel C-40 as the material with σ_y = 324.6 MPa for the bolts, determine the size of the bolts also considering the initial tension for the following cases:
(i) Metal to metal joint
(ii) A gasket joint **(10 Marks)**

Module-4

7 Design a pair of spur gear 20° full depth involute to transmit 30 KW of power at 600 rpm of pinion. Number of teeth on pinion is 15. Transmission ratio (gear reduction ratio) is 5. Material of the pinion is cast steel untreated having σ_y as 137.34 MPa. Material of the gear is high grade cast iron having σ_y as 103.005 MPa. Take service factor (C_S) as 1.5. **(20 Marks)**

OR

8 A pair of helical gears for a turbine has a transmission ratio of 10 and the teeth are $14\frac{1}{2}$ involute. The pinion has 25 teeth and rotates at 5000 rpm. Material for both pinion and gear is 0.4% carbon steel heat treated having σ_y as 86.03 MPa. Power to be transmitted at 100 KW. Design the gears completely. Take helix angle $\beta = 20°$. **(20 Marks)**

Module-5

9 a. Design a single plate clutch used in automobile transmission for the following specification: Power to be transmitted = 20 KW, speed = 1500 rpm. Take μ = 0.35, pressure (p) = 1 N/mm^2, yield stress for shaft material = 328.6 MPa. **(08 Marks)**

b. A simple band brake is required to transmit a torque of 980 N-m. The brake drum is 400 mm diameter and coefficient of friction is 0.25. Find the effort required to operate the brake. Also design the band and the lever. Take θ = 270°, a = 680 mm and b = 80 mm. Yield stress (σ_y) for both band and lever = 328.6 MPa.

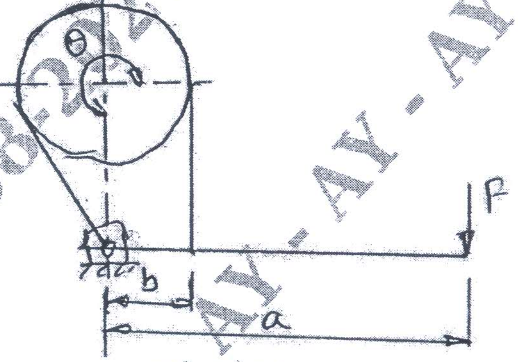

Fig.Q9(b) **(12 Marks)**

OR

10 a. Derive Petroff's equation with usual notations. **(10 Marks)**

b. A lightly loaded journal bearing has a load of 1 kN. The oil used is SAE 60 and mean effective temperature of operation is 40°C. The journal has a diameter of 50 mm and the bearing has a diameter of 50.5 mm. The speed of journal is 15000 rpm. The L/d ratio is limited to 1.2. Determine the coefficient of friction and power loss in friction. **(10 Marks)**

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