CBCS SCHEME

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15MT51

Fifth Semester B.E. Degree Examination, July/August 2022
Design of Machine Elements

Time: 3 hrs. Max. Marks: 80

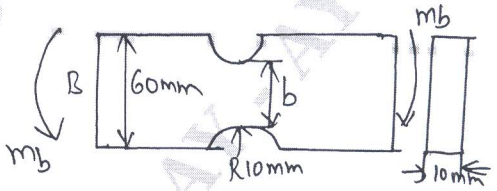
Note : 1. ***Answer any FIVE full questions, choosing ONE full question from each module.***
2. ***Use of Design data handbook is permitted.***

Module-1

1 a. Define Machine design and explain the basic design procedure. **(08 Marks)**

b. A Notch shown in the Fig. Q1(b) is subjected to bending moment of 10N-m. Determine the value of maximum stress by taking stress concentration in account. **(08 Marks)**

Fig. Q1(b)



OR

2 a. Explain the following theories of Failure :
i) Maximum Normal stress theory ii) Maximum Shear stress theory. **(08 Marks)**

b. Stresses induced at a critical point in a machine component is made up of 45C-8 with yield stress 380MPa are as follows : $\sigma_x = 100MPa$, $\sigma_y = 40MPa$ and $\tau_{xy} = 80MPa$. Determine FOS by i) Max Normal Stress theory ii) Max Shear Stress theory
iii) Max Distortion Energy theory. **(08 Marks)**

Module-2

3 Design a Cotter Joint to resist a load of 40kN which acts along the axis of the rod connected by the Cotter. The material of the rod and cotter is same and has the following properties $J = 160MPa$, $\sigma_t = 200MPA$, $\sigma_c = 420MPa$. Take FOS = 4. **(16 Marks)**

OR

4 a. Explain Self locking and Overhauling in power screws. **(06 Marks)**

b. Design a socket and spigot type cotter joint to sustain an axial load of 100kN. The material selected for the Joint has the following stresses : $\sigma_1 = 100N/mm^2$, $\sigma_c = 150N/mm^2$ and $\tau = 60N/mm^2$. **(10 Marks)**

Module-3

5 A horizontal piece of commercial shafting is supported by 2 bearing 1.5m apart. A keyed gear 20° involute and 175mm in diameter is located 400mm to the left of the right bearing and is driven by a gear directly behind it. A 600mm diameter pulley is keyed to the shaft 600mm 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 derive transmit 45KW at 330 rpm. Take $K_b = K_t = 1.5$. Calculate the necessary diameter of the shaft. Use allowable shear stress = 40MPa. **(16 Marks)**

OR

6 A shaft is supported between 2 bearing placed 1m apart. A 600mm diameter pulley is mounted at a distance of 300mm to the right of left hand bearing and this devices a pulley directly below with the help of belt with maximum tension of 2.25kN. Another pulley 400mm diameter is placed 200mm to the left of the right hand bearing and is driven with the help of Electric motor and belt which is placed horizontally to the right. The angle of contact for both the pulley is 180° and coefficient of friction is 0.24. Determine the suitable diameter for the solid shaft allowing a working stress of 63MPa in tension and 42MPa in shear. **(16 Marks)**

Module-4

7 a. Explain the classification of Gears **(04 Marks)**

b. A pair of carefully cut spur gears with 20° full depth involute profile is used to transmit 12KW at 1200 rpm of pinion. The gear has to rotate at 300 rpm. The material used for both pinion and gear is medium carbon steel. Whose allowable bending stress may be taken as 230MPa. Determine the Module and Face width of the Spur gear and Pinion. Suggest suitable hardness. Take 24 teeth on Pinion. Modulus of Elasticity = 210 GPa. **(12 Marks)**

OR

8 A pair of helical gears are used to transmit 15KW. The teeth are 20° FDI in the normal plane and having helix angle 30°. Pinion has 24 teeth and operates at 10,000 rpm. The velocity ratio is 5:1. Pinion is made of cost steel , σ_d = 50MPa and Gear of bronze σ_d = 40MPa. Check for dynamic and Wear strength. Take Precision gear. **(16 Marks)**

Module-5

9 a. Derive Petroff's equation with assumptions. **(06 Marks)**

b. Determine the dimensions of bearing and Journal to support a load of 7.5kN at 1000 rpm. The Journal is made of hardened steel and the bearing is of Babbit material abundance of oil supplied by oil rings. The oil viscosity is 300 say bolt seconds at 40°C and specific gravity is 0.915 at 15.5°C. The operating temperature of the oil is 75°C alloys a clearance of 0.001mm per mm diameter. Also find the minimum film thickness. Assume suitable data. **(10 Marks)**

OR

10 a. Explain the types of Springs. **(08 Marks)**

b. Determine the required number of coils at permissible deflection in a helical spring made of 1.5mm steel wire assuming C = 6, allowable shear stress = 335MPa. Stiffness of the spring is to be 1.75N/mm and G = 8×10^4 N/mm^2. **(08 Marks)**

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