CBCS SCHEME

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21ME63

Sixth Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025
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 design data hand book is allowed.
3. Missing data can be suitably assumed.

Module-1

1 a. Draw the stress-strain curve for mild steel and cast iron. Name the salient points. **(05 Marks)**

b. An unknown weight fails through 15 mm on a collar rigidly attached to the lower end of a vertical bar 3 m long and 500 mm^2 in section. If the maximum instantaneous extension is known to be 2 mm. What is the corresponding stress and the value of un-known weight. Take E = 200 KN/mm^2. **(10 Marks)**

c. An element is acted upon by the following stresses $\sigma_x = 120$ MPa ; $\sigma_y = 90$ MPa and $\tau_{xy} = 30$ MPa.

(i) Compute stresses on a plane inclined at 20°.
(ii) Find principal stresses and their direction.
(iii) Find maximum shear stress and its direction.

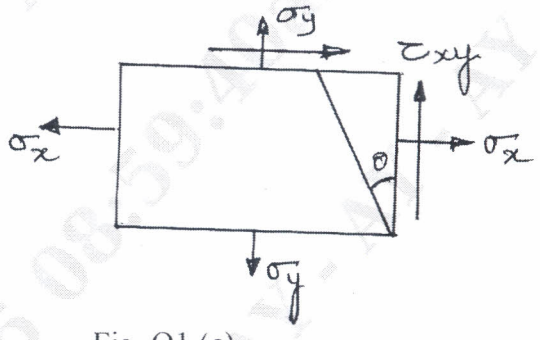

Fig. Q1 (c) **(05 Marks)**

OR

2 a. What are important mechanical properties of metals? Explain any three briefly. **(05 Marks)**

b. Derive the Soderberg's equation. **(05 Marks)**

c. Determine the Safe Load that can be carried by a bar of rectangular cross section shown in Fig. Q2 (c) limiting the maximum stress to 130 MPa. Take stress concentration into account.

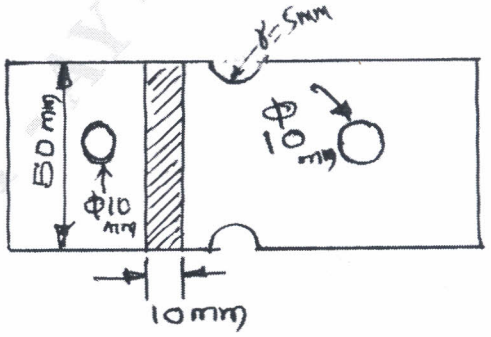

Fig. Q2 (c) **(10 Marks)**

Module-2

3 a. A hollow shaft of 50 mm outside diameter and 30 mm inside diameter, 300 mm long is subjected to a torque of 4 N-m. What is the angle of twist if modulus of rigidity is 90 GPa. **(05 Marks)**

b. Design flange coupling to connect the shafts of a motor and a centrifugal pump. Take factor of safety = 2 ; Allowable shear stress for CI flange = 15 MPa, Pump output = 3000 litre/min
Total head = 20 m
Pump speed = 600 rpm,
Pump efficiency = 70%
C40 steel shaft with $\sigma_y = 328.6$ MPa,
C30 steel for bolts and key with $\sigma_y = 294.2$ MPa. **(10 Marks)**

c. What is coupling? What are the requirements of a good coupling? **(05 Marks)**

OR

4 a. A simply supported shaft has the distance between supports as 600 mm. The load at the center is 15 KN. If the deflection at the center is to be limited to 0.02 mm. What should be the diameter of the shaft? If the shaft diameter is doubled, what will be the deflection at center? The modulus of elasticity is 210 GPa. **(10 Marks)**

b. Design a helical compression spring to sustain an axial load of 3 kN. The deflection is 60 mm, spring index is '6'. The shear stress is not to exceed 300 MPa. Rigidity modulus of the spring is 81 GPa. **(10 Marks)**

Module-3

5 a. Design a double riveted Lap joint to connect two plates each 20 mm thick. The allowable stress for rivets and plates are 90 MPa in tension, 60 MPa in shear and 150 MPa in crushing. **(10 Marks)**

b. Determine the size of weld for a joint shown in Fig. Q5 (b). The allowable stress in the weld is 70 MPa. **(05 Marks)**

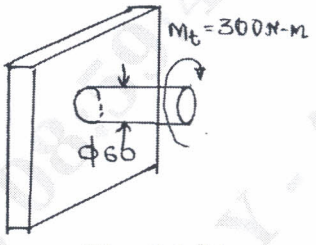

Fig. Q5 (b)

c. Classify Rivited joints, sketch them neatly. **(05 Marks)**

OR

6 a. List different types of fasteners and their uses. **(05 Marks)**

b. Determine the size of the weld to be used for a bracket as shown in the Fig. Q6 (b). The load is 30 kN. **(15 Marks)**

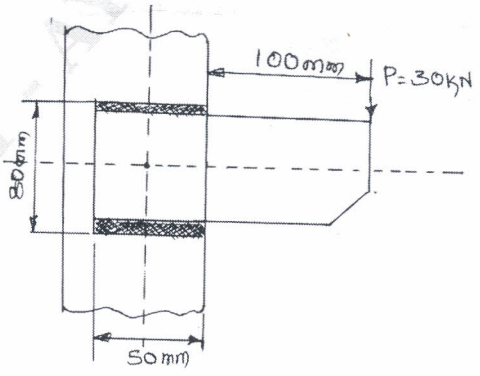

Fig. Q6 (b)

Module-4

7 Design a pair of helical gear to transmit 12 kW at 1200 rpm of pinion. The velocity ratio is 3 : 1, pinion has 24 teeth and is made of 0.4% carbon steel untreated. The gear is made of cast steel, the teeth are $14\frac{1}{2}^{\circ}$ involute form in normal plane Helix angle is 25°. **(20 Marks)**

OR

8 Design a pair of Right angle bevel gears to transmit 25 kW from a shaft rotating at 1200 rpm to another shaft to rotate at 500 rpm. **(20 Marks)**

Module-5

9 a. List important properties of Lubricants and briefly define any four. **(06 Marks)**

b. Design the main bearings of a 4-stroke diesel engine to sustain a load of 6 kN. The operating speed of the shaft is 100 rpm. **(14 Marks)**

OR

10 a. A single block brake with drum diameter of 350 mm is shown in Fig. Q10. The angle of contact is 90° coefficient of friction is 0.33. Determine safe power that can be absorbed at 1440 rpm. **(10 Marks)**

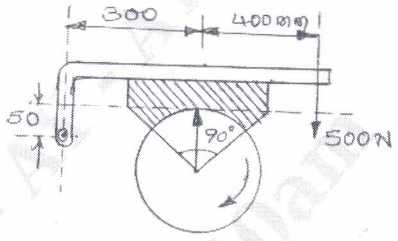

Fig. Q10 (a)

b. List various condition of Lubrication and briefly describe each. **(10 Marks)**

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