CBCS SCHEME

USN ☐☐☐☐☐☐☐☐☐☐ **15MA54**

Fifth Semester B.E. Degree Examination, Feb./Mar. 2022
Elements of Machine Design

Time: 3 hrs.   Max. Marks: 80

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

Module-1

1 a. Explain three theories of failure. **(08 Marks)**
  b. A notched plate as shown in Fig.Q1(b) is subjected to bending moment of 10 N-m. Determine the maximum stress induced in member by taking the stress concentration into account. **(08 Marks)**
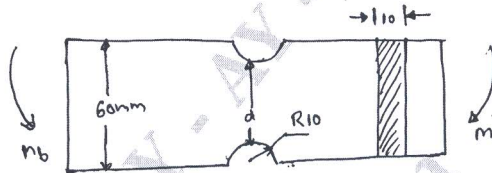

Fig.Q1(b)

OR

2 a. Derive an equation for stress due to axial load. **(08 Marks)**
  b. In a flange coupling used to connect two coaxial shafts of diameter 80mm to transmit 60 kW at 200 rpm, 6 bolts of $M_{14} \times 1.5$ are used on a bolt circle diameter of 240mm. The hub diameter is 150mm and flange thickness is 20mm determine (i) Shear stress induced in shaft (ii) Shear stress induced in bolt. **(08 Marks)**

Module-2

3 a. Derive an equation for Soderberg relationship. **(04 Marks)**
  b. A piston rod is subjected to a maximum reversed axial load of 110 kN. It is made of steel having an ultimate stress of 900 N/mm^2 and surface is machined. The average endurance limit is 50% of ultimate strength. Take size correction coefficient as 0.85 and factor of safety 1.75. Determine the diameter of rod. **(12 Marks)**

OR

4 A solid steel shaft running at 600 rpm is supported on bearings 600mm apart. The shaft receives 40 kW through 400mm diameter pulley weighing 400 N located 300mm to the right of left bearing by a vertical flat bell drive. The power is transmitted from the shaft through another pulley of diameter 600mm weighing 600N located 200mm to the right of the right bearing. The belt drives are at right angles to each other and ratio of belt tensions is 3. Determine the size of shaft necessary. If the allowable shear stress in shaft material is 40 MPa and the loads are steady. **(16 Marks)**

Module-3

5 Design a pair of spur gears to transmit 20 kW from a shaft rotating at 1000 rpm to a parallel shaft which rotate at 310 rpm. Assume number of teeth on pinion 31 and 20° full depth tooth form. The material for pinion is C40 steel untreated and for gear cast steel 0.20% C untreated. **(16 Marks)**

OR

6   Design a pair of bevel gears to connect two shafts at 60°. The gears are alloy steel of case hardened and precision cut with form cutters. The gear ratio is 5:1. The power transmitted is 30 kW at 900 rpm of the pinion. The teeth are 20° full depth, The pinion has 24 teeth. Check the gears for dynamic load and wear considerations.   **(16 Marks)**

Module-4

7   a.   A rectangular key 14mm wide × 10mm thick × 75mm long is required to transmit 1200 N-m torque from a 50mm diameter solid shaft. Determine whether the length is sufficient or not if the permissible shear stress and crushing stress limited to 56 MPa and 168 MPa respectively.   **(08 Marks)**

   b.   Design a knuckle joint to connect two mild steel rods subjected to an axial pull of 100 kN. The allowable stresses for rods and pin are 100 MPa, 130 MPa and 60 MPa in tension. Crushing and shear respectively. The bending of the pin is prevented by selection of proper fit.   **(08 Marks)**

OR

8   A bush pin type flexible coupling has four pins of size M_{16}, made of steel having allowable shear stress of 60 MPa. The outside diameter and length of rubber bush on the pin are 38mm and 45mm respectively. The pins are located on a pitch circle of diameter 200mm. The allowable bearing pressure in the rubber bush is 1.0 MPa. If the coupling rotates at 900 rpm. Calculate the power that can be transmitted. Check whether the size of pin is acceptable for power transmitted.   **(16 Marks)**

Module-5

9   a.   Define Viscosity, Lubricant.   **(04 Marks)**
   b.   Write a note on bearing modulus.   **(06 Marks)**
   c.   List and explain properties of lubricants.   **(06 Marks)**

OR

10   A full journal bearing of 50mm diameter, 75mm long supports a radial load of 1000N. The speed of the shaft is 600 rpm. The surface temperature of bearing is limited to 60°C, and the room temperature is 30°C. Determine the viscosity of the oil if the bearing is well ventilated and no artificial cooling is used. The ratio of journal to diametrical clearance is 1000.   **(16 Marks)**

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