CBCS SCHEME

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18MT52

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

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 permitted.
3. Missing data may be suitably assumed.

Module-1

1 a. Define factor of safety and explain codes and standards. **(06 Marks)**

b. List the factors which govern the selection of material for a machine component. **(05 Marks)**

c. Determine the maximum stress induced in the semi circular grooved shaft shown in Fig. Q1 (c), if it is subjected to,
(i) A bending moment of 400 N-m. (ii) A twisting moment of 500 N-m.
Take the stress concentration into account.

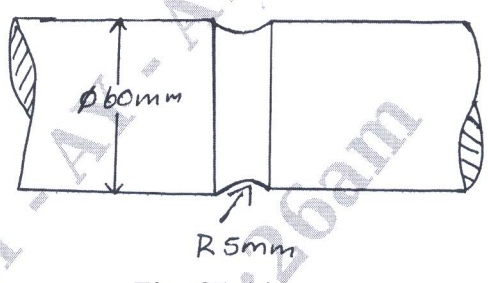

Fig. Q1 (c) **(09 Marks)**

OR

2 a. Define stress concentration and explain the methods of reducing stress concentration. **(05 Marks)**

b. State and explain maximum normal stress theory and maximum shear stress theory. **(06 Marks)**

c. A rod of circular section is to sustain a torsional moment of 300 kN-m and bending moment 200 kN-m, selecting C45 steel (σ_{yt} = 353 MPa) and assuming FOS = 3, determine the diameter of rod as per following theories of failure,
(i) Maximum shear stress theory (ii) Distortion Energy theory. **(09 Marks)**

Module-2

3 a. Derive Goodman's equation when a member subjected to Fatigue axial loading. **(05 Marks)**

b. Sketch and explain cumulative fatigue damage. **(05 Marks)**

c. Determine the maximum load for the simply supported beam, cyclically loaded as shown in Fig. Q3 (c). The ultimate strength is 700 MPa, the yield point in tension is 520 MPa and the endurance limit in reversed bending is 320 MPa. Use a factor of safety of 1.25. The load, size and surface correction factors are 1, 0.75 and 0.9 respectively.

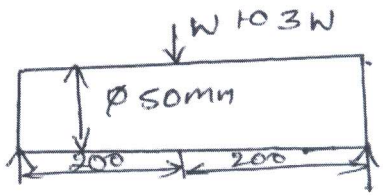

Fig. Q3 (c) **(10 Marks)**

OR

4 a. Define Endurance limit. Explain the factors affecting Endurance limit. **(08 Marks)**

b. A round rod of diameter 1.2 d is reduced to a diameter 'd' with fillet radius of 0.1 d. This stepped rod is to sustain a twisting moment that fluctuates between +2.5 kN-m and +1.5 kN-m together with a bending moment that fluctuates between +1 kN-m and −1 kN-m. The rod is made of carbon steel C40. ($\sigma_y = 328.6$ MPa; $\sigma_u = 620$ MPa). Determine a suitable value for 'd'. **(12 Marks)**

Module-3

5 a. Derive an expression for torque required to raise/lower the load on squared threaded screw. **(10 Marks)**

b. A weight of 500 kN is raised at a speed of 6 m/min by two screw rods with square threads of 50×8 cut on them. The two screw rods are driven through bevel gear drives by a motor, determine

(i) The torque required to raise the load.
(ii) The speed of rotation of the screw rod assuming the threads are of double start.
(iii) The maximum stress induced on the cross section of the screw rod.
(iv) The efficiency of screw drive.
(v) The length of nuts for the purpose of supporting the load and
(vi) Check for overhaul. **(10 Marks)**

OR

6 a. Design a valve spring for an automobile engine, when the valve is closed, the spring produces a force of 45 N and when it opens produces a force of 55 N. The spring must fit over the valve bush which has an outside diameter of 20 mm and must go inside a space of 35 mm. The lift of the valve is 6 mm. The spring index is 12. The allowable stress may be taken as 0.33 GPa modulus of rigidity 80 GPa. **(10 Marks)**

b. Define self locking. Derive an expression for stress in helical springs of circular wire. **(10 Marks)**

Module-4

7 Design a pair of spur gear to transmit a power of 18 kW from a shaft running at 1000 rpm to a parallel shaft to be run at 250 rpm maintaining a distance of 160 mm between the shaft centres. Suggest suitable surface hardness for the gear pair. **(20 Marks)**

OR

8 Design a pair of helical gear to transmit power of 15 kW at 320 rpm with speed reduction 4 : 1 pinion is made of cast steel 0.4 % C untreated. Gear is made of high grade CI. Helix angle is limited to 26° and not less than 20 teeth are to be used on either gear. Suggest suitable surface hardness for the gear pair. **(20 Marks)**

Module-5

9 a. Define FEM. Explain the applications of FEM. **(06 Marks)**

b. Briefly explain Discretization process. **(04 Marks)**

c. Find the nodal displacement, stress in the thickest section and left section reaction for the structure shown in Fig. Q9 (c). **(10 Marks)**

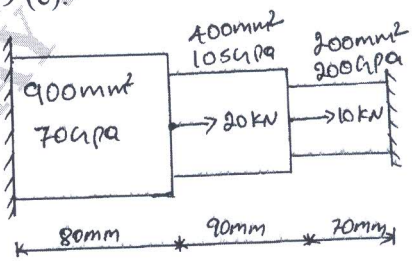

Fig. Q9 (c)

OR

10 a. Derive the stiffness matrix for bar element. **(08 Marks)**

b. Consider the bar shown in Fig.Q10 (b). An axial load $P = 60 \times 10^3$ N is applied at its mid point using penalty method of handling boundary condition determine the nodal displacement and support reactions. **(12 Marks)**

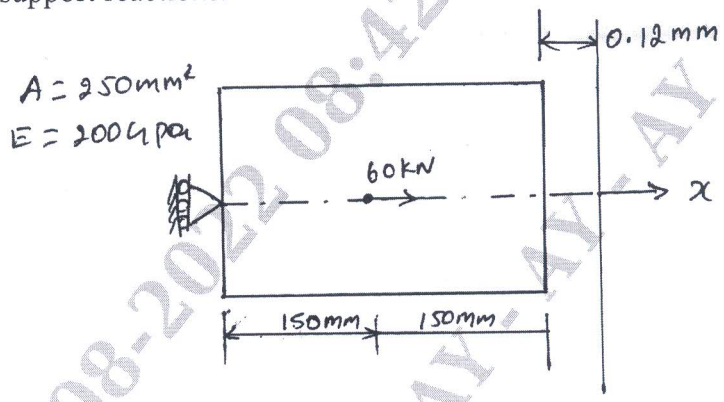

Fig. Q10 (b)

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