CBCS SCHEME

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18IP52

Fifth Semester B.E. Degree Examination, July/August 2021
Design of Machine Elements

Time: 3 hrs. Max. Marks: 100

Note: ***1. Answer any FIVE full questions.***
2. Design Data hand book is permitted.
3. Assume missing data suitably.

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

1 a. What are the factors to be considered for selection of material for a machine component? **(06 Marks)**

b. Explain:
i) Maximum principal stress theory
ii) Maximum shear stress theory. **(06 Marks)**

c. A stepped shaft stepped down from 50mm diameter to 25mm diameter with a fillet radius of 5mm is subjected to an axial pull of 10kN. Determine the maximum stress induced in the member taking stress concentration into account. **(08 Marks)**

2 a. What is stress concentration? Explain the factors affecting the stress concentration. **(06 Marks)**

b. Draw the stress strain diagram for a ductile material and show the salient points on them. **(06 Marks)**

c. Determine the max stress induced in the following cases taking stress concentration into account:
i) A rectangular plate 50mm wide, 8mm thick and with a central hole of 10mm is loaded in axial tension of 14.7kN.
ii) A stepped shaft, stepped down from 45mm to 30mm with a fillet radius of 6mm is subjected to a twisting moment of 98N-m. **(08 Marks)**

3 a. From first principle derive Soderberg equation. **(08 Marks)**

b. A carbon steel shaft with σ_u = 600MPa, σ_y = 330MPa is subjected to bending moment varying from 100N-m and 200N-m and torsional moment varying from 200N-m and 400N-m. The maximum bending moment occurs at the same time as that of maximum torsional moment. Determine the diameter of the shaft required for a factor of safety is 3. **(12 Marks)**

4 a. Explain briefly the following:
i) Endurance limit
ii) High cycle and low cycle fatigue. **(04 Marks)**

b. A simply supported beam has a concentrated load at the centre which fluctuates from a value of p to 4p. The span of beam is 500mm and its cross section is circular with a diameter of 60mm. Taking for the beam material an ultimate stress of 700MPa, a yield stress of 500MPa, endurance limit of 330MPa for reversed bending and a factor of safety of 1.3. Calculate the max load of P. Take of size factor of 0.85, a surface finish factor of 0.9 and fatigue stress concentration factor of 1. **(16 Marks)**

5 A mild steel shaft transmits 20kW at 200rpm. It carries a central load of 900N and is simply supported between the bearings 2.5m apart. Determine the size of the shaft, If the allowable shear stress is 42MPa and the max tensile or compressive stress is not to exceed 56MPa. What size of the shaft will be required, if it is subjected to gradually applied loads. **(20 Marks)**

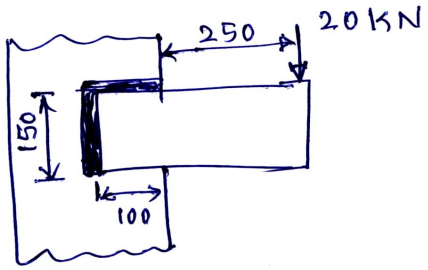
6 A hollow shaft 0.5m outside diameter, and 0.3m inside diameter is supported by two bearings 6m apart, the shaft is driven by a flexible coupling at one end and drives a ship's propeller at 10.5 rad/sec. The max-thrust on the propeller is 540kN when the shaft is transmitting 5885 kW. The shaft weight is 67.5kN. Determine the max shear stress in the shaft considering the weight of the shaft and the column effect. Assume $K_b = 1.5$ and $K_t = 1.0$. **(20 Marks)**

7 Design a pair of steel gears required to transmit 12kW at 2000rpm of pinion. The velocity ratio received is 2.5:1. The allowable static stress for both may be taken as 138MPa. Not less than 24 teeth are to be used on either gear. The teeth are 20° stub teeth. **(20 Marks)**

8 Two shafts inclined at 60° are connected by a pair of bevel gears to transmit 9kW at 900rpm of 24 tooth cast steel pinion having allowable static stress of 138MPa. The gear is made of high grade CI having allowable static stress of 103MPa and is to run at 300rpm. The teeth are $14\frac{1^\circ}{2}$ involute form. Design the gears completely. **(20 Marks)**

9 a. Explain failure of riveted joints with sketches. **(08 Marks)**

b. A 16mm thick plate is welded to a vertical support by two fillet welds as shown in Fig.Q.9(b). Determine the size of the weld if the permissible shear stress for the weld material is $75N/mm^2$.



All dimensions are in mm

Fig.Q.9(b)

(12 Marks)

10 a. A laminated spring having 6 graduated leaves is simply supported at ends at a distance of 0.9m. It is made of steel having allowable bending stress of 360MPa. The width and thickness of leaves are 90mm and 6mm. Find the safe load that can be carried by this spring at the middle and the deflection under that load. Take E = 206GPa. **(08 Marks)**

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

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