CBCS SCHEME

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18RA52

Fifth Semester B.Tech. Degree Examination, Jan./Feb. 2023
Design and 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 assumed suitably.

Module-1

1 a. Define tri-axial stresses and stress tensor. **(06 Marks)**

b. What is factor of safety? What are the factors to be considered while selecting factor of safety? **(06 Marks)**

c. The flat bar shown in Fig.Q1(c), is subjected to a load of 10 kN in tension. Determine the thickness of the flat, if the maximum stress is limited to 200 N/mm^2. D = 200mm.

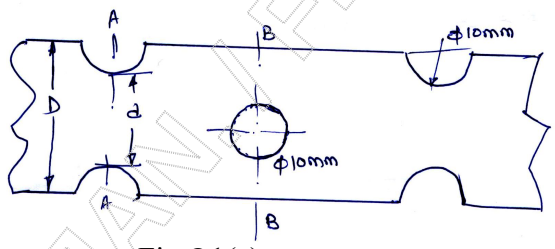

Fig.Q1(c) **(08 Marks)**

OR

2 a. Explain various theories of failures in short by mentioning their application. **(06 Marks)**

b. What is stress concentration, define and explain the methods of reducing stress concentration. **(06 Marks)**

c. The state of stress in a body are σ_x = 81 MPa, σ_y = 21 MPa and τ_{xy} = 84 MPa. The yield stress of material is 280 MPa. Find the factor of safety according to maximum shear stress theory and distortion energy theory. **(08 Marks)**

Module-2

3 a. Derive an equation for "Goodman Theory". **(06 Marks)**

b. Define Endurance limit. **(02 Marks)**

c. A portion of machine member shown in Fig.Q3(c). It is loaded by completely reversed axial load 'F', which are uniformly distributed across the width. The material is cold-drawn steel with yield stress ρ_{yt} = 385 MPa, and ultimate strength ρ_{ut} = 530 MPa for 90% reliability and infinite life, determine the maximum force 'F' that can be applied.

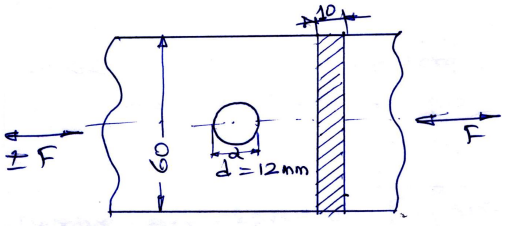

Fig.Q3(c) **(12 Marks)**

OR

4 a. Derive an equation for Soderberg criterion. **(06 Marks)**

b. Differentiate between fluctuating stress repeated stress and reversed stress. **(06 Marks)**

c. A machine member made of oil quenched high strength steel SAE 1095, is subjected to the following four phases of reversed cycles if the effective endurance strength of component is 600 MPa, compute cycles of life for the machine part.

Cycle	Stress	% of time
Cycle I	σ_1 = 650 MPa	70%
Cycle II	σ_2 = 700 MPa	15%
Cycle III	σ_3 = 750 MPa	10%
Cycle IV	σ_4 = 800 MPa	5%

(08 Marks)

Module-3

5 a. Write the steps followed while designing a power screw. **(08 Marks)**

b. Explain self-locking and overhauling of screw. **(04 Marks)**

c. Derive an expression for torque required to raise/lower the load on square threaded screw. **(08 Marks)**

OR

6 a. Derive an expression for stress in helical spring made of circular wire. **(08 Marks)**

b. A load of 1 kN is dropped axially on a closed coil helical compression spring from a height of 250mm. The spring has 20 active turns made from 20mm wire diameter and spring index is 8, determine the deflection and maximum shear stress induced in the spring. Take G = 84 GPa. **(12 Marks)**

Module-4

7 Design a pair of spur gears to transmit a power of 18 kW, from a shaft running at 1000 rpm to a parallel shaft to be run at 250 rpm. Centre distance between the shafts is 160mm. Suggest suitable surface hardness for the gear pair based on dynamic and wear condition. **(20 Marks)**

OR

8 Design a pair of helical gears to transmit a power of 20 kW from a shaft running at 1500 rpm to a parallel shaft to be run at 450 rpm. Centre distance between the shaft is 160mm. Suggest suitable surface hardness for the gear pair based on dynamic and wear consideration. **(20 Marks)**

Module-5

9 a. What is FEM? Explain steps to solve a problem by using FEM. **(06 Marks)**

b. Explain with neat sketches the different elements used in FEM. **(06 Marks)**

c. Determine the nodal displacement, stress, reaction force, for the bar shown in Fig.Q9(c), using FEM.

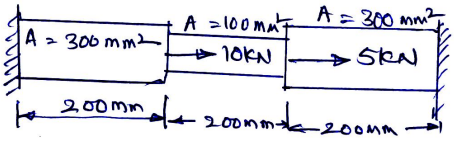

Fig.Q9(c) **(08 Marks)**

OR

10 a. List advantages and disadvantages of FEM. **(06 Marks)**

b. What is stiffness matrix and what are properties of stiffness matrix? **(06 Marks)**

c. Derive an expression for stiffness matrix of 2 noded 1D – bar element. **(08 Marks)**

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