CBCS SCHEME

USN | | | | | | | | | | | **18SM52**

Fifth Semester B.Tech. Degree Examination, Jan./Feb. 2023
Machine Design

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Explain the general procedure in machine design. **(08 Marks)**

b. A circular shaft of diameter 50mm is subjected to load as shown in Fig.Q.1(b). Determine the nature and magnitude of stresses at the critical points. **(12 Marks)**

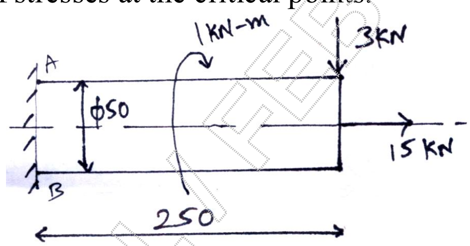

Fig.Q.1(b)

OR

2 a. Explain below failure theories.

i) Maximum principal stress theory.

ii) Maximum distortion energy theory. **(08 Marks)**

b. A flat bar shown in Fig.Q.2(b) is subjected to an axial load of 100kN. Assuming that the stress in the bar is limited to $200 N/m^2$. Determine the thickness of bar. **(12 Marks)**

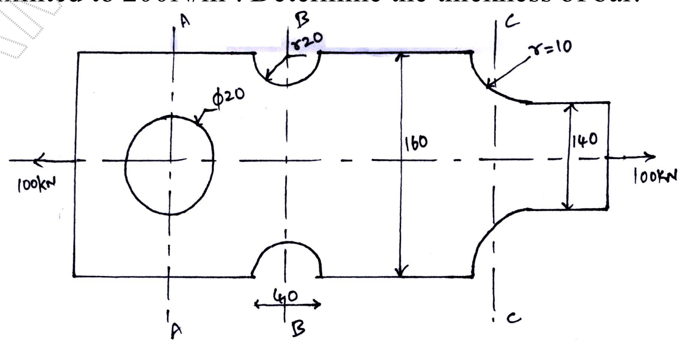

Fig.Q.2(b)

Module-2

3 a. Derive the Soderberg equation. **(06 Marks)**

b. A steel rod (SAE 9260 oil quenched σ_{ut} = 1089.5MPa, σ_{yt} = 689.4MPa, σ_{-1} = 427.6MPa) is subjected to a tensile load which varies from 120kN to 40kN. Design the safe diameter of the rod. Using Soderberg diagram. Adopt FOS as 2, stress concentration factor is unity and concentration factors for load, size and surface as 0.75, 0.85 and 0.91 respectively. **(14 Marks)**

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.

OR

4 A stepped shaft of circular cross section shown in Fig.Q.4 subjected to variable load which is completely reversed with a value equal to 100kN. It is made of SAE 1045 steel annealed (σ_u = 586.4MPa, σ_y = 309.9MPa, σ_{-1} = 289.3Mpa). Determine the diameter 'd' and radius 'r', so that the max stress will be limited to a value corresponding to a FOS of 2. Notch sensitivity index = 1. **(20 Marks)**

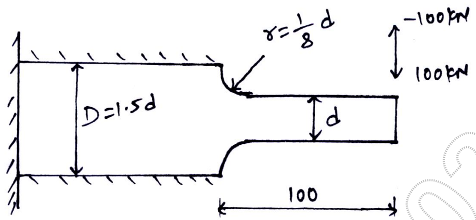

Fig.Q.4

Module-3

5 Design a protected type CI flange coupling for a steel transmitting 30kW at 200rpm. The allowable shear stress in the shaft and key material is 40MPa. The maximum torque transmitted to be 20% greater than the full load torque. The allowable shear stress in the bolt is 60MPa and the allowable shear stress in the flange is 40MPa. **(20 Marks)**

OR

6 Design a triple riveted butt joint to join two plates of thickness 10mm. The pitch of rivets in the extreme rows, which are in single shear is twice the pitch of rivets in the inner rows which are double shear. The design stresses of the material of the main plate and the rivets are as follows:
For plate material in tension = 120MPa
For rivet material in compression = 160MPa
For rivet material in shear = 80MPa
Draw neat sketch of joint in two views. **(20 Marks)**

Module-4

7 Design a helical compression spring to support an axial load of 3000N. The deflection under load is limited to 60mm. The spring index is 6. The spring is made of chrome-vanadium steel and FOS in 2. **(20 Marks)**

OR

8 Design a leaf spring for the following specification for a truck, total load = 120kN, number of springs = 4. Material for the spring is chrome-vanadium steel. Permissible stress is 0.55GPa. Span of spring = 1100mm. Width of central band = 100mm and allowable deflection = 80mm. Number of full length leaves are 2 and graduated leaves 6. **(20 Marks)**

Module-5

9 a. Write a brief note on ductile and brittle fracture. **(10 Marks)**
b. Derive Griffith's energy balance equation considering wide plate subjected to remote tensile load. **(10 Marks)**

OR

10 a. With neat sketch, explain modes of failure. **(10 Marks)**
b. Derive K_{eff} using Arwin's approach. **(10 Marks)**

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