CBCS SCHEME

USN | | | | | | | | | | **18ME52**

Fifth Semester B.E. Degree Examination, Dec.2024/Jan.2025
Design of Machine Elements – I

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. Assume suitable missing data.

Module-1

1 a. Define mechanical engineering design, Explain the steps involved in design with a block diagram. **(08 Marks)**

b. Determine the max stress induced in the semicircular grooved shaft as shown in Fig. Q1 (b), if it is subjected to,
   (i) An axial load of 50 kN
   (ii) A bending moment of 500 Nm.
   (iii) A twisting moment of 400 Nm. **(12 Marks)**

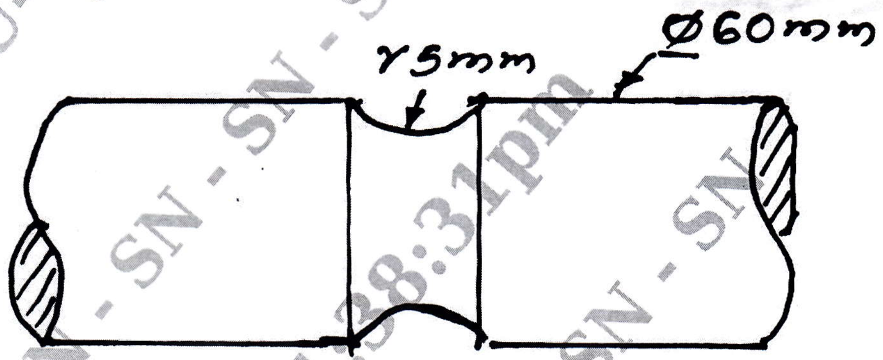

Fig. Q1 (b)

OR

2 a. Define stress concentration and discuss about the methods (any two) to reduce stress concentration. **(08 Marks)**

b. A Cantilever beam of rectangular cross section with a depth of 200 mm is subjected to an axial tensile load of 50 kN and a transverse load of 40 kN acting downwards at the free end of 500 mm length beam. The material of the beam has allowable tensile stress of 80 N/mm^2. Determine the width of rectangular section of the beam. **(12 Marks)**

Module-2

3 a. Derive an expression for impact stress in an axial bar of cross section 'A' and length 'L' due to the impact load of 'W' falling from a height 'h' on the collar. **(08 Marks)**

b. A Cantilever beam of rectangular section with the depth twice the width is subjected to varying load that varies from 6 KN downwards to 2 KN upwards. If the span is 100 mm, determine the dimensions of cross section of the beam. The material has yield strength of 400 N/mm^2 and a tensile strength of 560 N/mm^2. Assume no stress raisers, size factor and surface finish factors as 1. Factor of safety is 2. **(12 Marks)**

OR

4 a. Explain with neat sketches, the different types of varying stresses. **(06 Marks)**

b. A beam of 400 mm depth I-section is resting on two supports 6 m apart. It is loaded by a weight of 5 KN falling through a height of 10 mm and striking the beam at mid point. Moment of Inertia of the section is 12×10^7 mm^4. Take Modulus of Elasticity of 2×10^5 N/mm^2. Determine,

(i) Impact stress
(ii) Impact factor
(iii) Instantaneous max deflection
(iv) Instantaneous max load. **(14 Marks)**

Module-3

5 A shaft mounted between bearings 1200 mm apart receives a power of 20 kW at 1000 rpm through a pulley 600 mm diameter located 400 mm from the left bearing from antoher pulley directly below it. The power is delivered through a gear of 200 mm diameter located 700 mm from the left bearing to another gear in front of it. The shaft rotates clockwise when viewed through the left bearing. The belt has ratio of tensions of 2.5 and the gear is of 20° pressure angle. The weight of the pulley is 500 N and that of the gear is 200 N. Determine the shaft diameter if the shaft material has yield shear stress of 180 MPa and factor of safety is 3. Take shock and endurance factors for bending and torsion as 1.5 and 1.00 respectively. **(20 Marks)**

OR

6 a. Prove that a square key is equally strong in shear and compression. **(06 Marks)**

b. A Cast Iron Flange coupling is used to connect two shafts of 80 mm diameter. The shaft runs at 250 rpm and transmits a torque of 4300 N.m. The permissible shear stress for key and bolt materials is 50 MPa and permissible shear stress for Flange material is 8 MPa. Design the Flange key and bolts for the coupling. **(14 Marks)**

Module-4

7 a. Explain with neat sketch, the failure of rivets. **(06 Marks)**

b. Determine the size of weld required for an eccentricity loaded weld as shown in Fig.Q7 (b). The allowable stress in the weld is 75 MPa. **(14 Marks)**

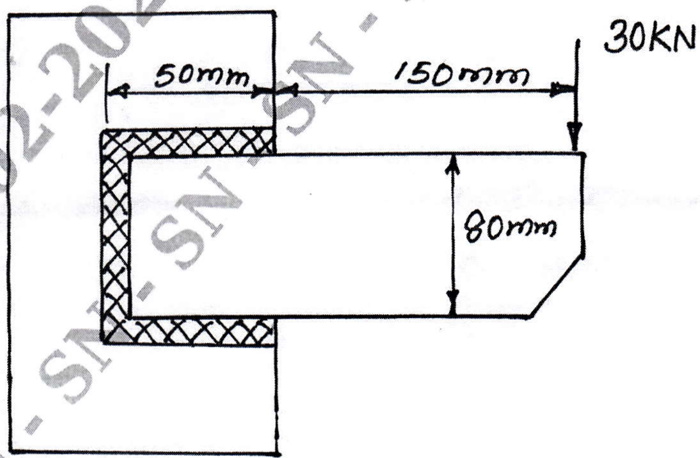

Fig. Q7 (b)

OR

8 a. A plate of 80 mm wide and 10 mm thick is welded to another plate by means of two parallel welds. Shear stress at the joint is 75 N/mm^2. Determine the length of weld of the plates are subjected to a load of 50 kN. **(06 Marks)**

b. Design a double riveted butt joint with two cover plates for the longitudinal seam of a boiler shell 1.5 m in diameter subjected to a steam pressure of 0.9 MPa. Assume joint efficiency of 75%. Allowable stress in tension for the plate is 83 MPa in compression 138 MPa and shear stress in rivets may be assumed as 55 MPa. Assume chain riveted joint. **(14 Marks)**

Module-5

9 a. Design a socket and spigot type cotter joint to sustain an axial load of 100 kN. The material selected for the joint has the following design stresses:
$\sigma_t = 100\ N/mm^2$, $\sigma_C = 120\ N/mm^2$, $\tau = 60\ N/mm^2$. **(10 Marks)**

b. A single threaded power screw of 25 m diameter with a pitch of 5 mm is used take a maximum load of 500 N. The coefficient of frictions are 0.05 for the collar and 0.08 for the screw. The frictional diameter of the collar is 30 mm. Find the torque required to raise and lower the load. Also find the efficiency of the power screw. **(10 Marks)**

OR

10 a. Explain self locking and overhaul in power screws. **(05 Marks)**

b. A square threaded power screw has a nominal diameter of 30 mm and a pitch of 6 mm with double start. Load on the screw is 6 kN and the mean diameter of the trust collar is 40 mm. The co-efficient of friction for screw is 0.1 and for collar is 0.09. Determine
(i) Torque required to raise load.
(ii) Torque required to lower the load.
(iii) Overall efficiency
(iv) Is the screw self locking? **(15 Marks)**

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