CBCS SCHEME

USN

15ME54

Fifth Semester B.E. Degree Examination, Dec.2019/Jan.2020

Design of Machine Elements – I

Time: 3 hrs. Max. Marks: 80

Note: 1. ***Answer FIVE full questions, choosing ONE full question from each module.***
2. Use of design data handbook is permitted.
3. Missing data if any may be assumed.

Module-1

1 a. What is mechanical engineering design? List the steps involved in design with a block diagram. **(04 Marks)**

b. A 50 mm diameter steel rod supports a load of 9 kN and in addition is subjected to a torsional moment of 100 N-m as shown in Fig. Q1 (b). Determine the maximum tensile and the maximum shear stress. **(08 Marks)**

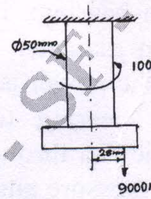

Fig. Q1 (b)

c. Explain the reasons for stress concentration in machine members and two methods adopted to reduce the same. **(04 Marks)**

OR

2 a. A machine element in the form of a Cantilever beam has a rectangular cross section of depth 200 mm. The beam is subjected to an axial tensile load of 60 KN and a transverse load of 50 KN acting downwards at the free end of the beam which has a span of 800 mm. Determine the width of rectangular cross section if the material of the beam is steel with an allowable tensile stress of 90 N/mm^2. (90 MPa) **(08 Marks)**

b. Determine the safe load that can be carried by a bar of rectangular cross section shown in Fig. Q2 (b) limiting the maximum normal stress to 130 MPa taking stress concentration into account. **(08 Marks)**

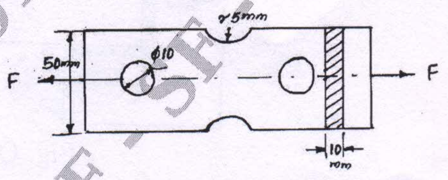

Fig. Q2 (b)

Module-2

3 a. Derive an expression for impact stress in an axial bar of cross section 'A' and length 'l' due to an impact load 'W' falling from a height 'h' on the bar. **(06 Marks)**

b. A Cantilever beam of rectangular cross section has a span of 800 mm. The rectangular cross section of the beam has a depth of 200 mm. The free end of the beam is subjected to a transverse load that fluctuates between 8 KN down to 5 KN up. The material for the beam is steel with an yield stress of 294 MPa, endurance strength of 275 MPa and factor of safety is 2.50. Determine the width of rectangular cross section taking surface finish factor as 0.95, size factor on 0.90 and stress concentration factor as 1.65. **(10 Marks)**

OR

4 a. Derive the Soderberg's equation for designing the members subjected to fatigue loading. (06 Marks)

b. A simply supported beam of span 1000 mm is subjected to a central load of 20 KN that falls from a height of 20 mm. The beam has a rectangular cross section of width 60 mm and depth 200 mm. The material of the beam has a modulus of elasticity of 207 GPa. Determine (i) Impact factor (ii) Instantaneous deflection (iii) Impact load. (10 Marks)

Module-3

5 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 $\sigma_t = 80\ N/mm^2$, $\tau = 60\ N/mm^2$, $\sigma_C = 150\ N/mm^2$. (08 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 bolt material is 50 MPa and permissible shear stress for flange is 8 MPa. Design bolts and the coupling. (08 Marks)

OR

6 A shaft mounted between bearings 1.2 m apart receives a power of 20 kW at 1000 rpm through a pulley 600 mm diameter located 400 mm from the left bearing from another 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 counterclockwise when viewed through the left bearing. The belt has a ratio of tensions of 2.5 and the gear is of 20° pressure angle. Determine the shaft diameter assuming the shaft to be made of steel with an yield shear stress of 180 MPa and factor of safety as 3. Take $K_b = 1.5$, $K_t = 1.0$. (16 Marks)

Module-4

7 a. Design a double riveted butt joint with equal width cover plates to join two plates of thickness 10 mm. The allowable stress for plate and rivets are $\sigma_t = 80$ MPa, $\tau = 60$ MPa and $\sigma_C = 120$MPa . (08 Marks)

b. Determine the size of weld required for an eccentrically loaded weld as shown in Fig. Q7 (b). The allowable stress in the weld is 75 MPa. (08 Marks)

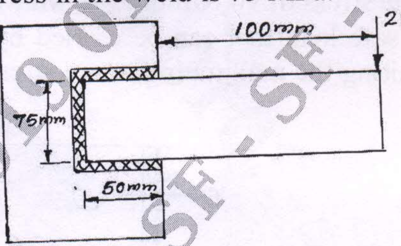

Fig. Q7 (b)

OR

8 a. Two lengths of a flat tie bar of 18 mm thick are connected by a butt joint with equal cover plates on either side. If a load of 400 KN is acting on the bar, design the joint such that the section of the bar is not weakened by more than one rivet hole. The working stresses for the material of the bar is 100 MPa in tension, for the material of the rivet 70 MPa in shear and 160 MPa in crushing. (10 Marks)

b. A plate of 80 mm wide and 15 mm thick is to be joined with another plate by a single transverse weld and a double parallel weld. Determine length of parallel weld if joint is subjected to static loading. Take $\sigma_t = 90$ MPa, $\tau = 55$ MPa an allowable stresses and stress concentration factor as 1.5 for transverse weld and 2.7 for parallel weld. (06 Marks)

Module-5

9 a. A cylinder head of a steam engine is subjected to a steam pressure of 0.8 MPa. It is held in position by means of 12 bolts. A soft copper gasket is used to make the joint leak proof. The bore diameter of the cylinder is 250 mm. Find the size of bolts so that the stress in bolts is not to exceed 110 MPa. **(08 Marks)**

b. The lead screw of a lathe has single start ISO trapezoidal threads of 30 mm outside diameter and 6 mm pitch. It drives a tool carriage and exerts an axial load of 1.5 KN on a thrust collar of 30 mm inside diameter and 50 mm outside diameter. If the lead screw rotates at 40 rpm, find the power required to drive the screw. Take coefficient of friction for power screw as 0.14 and for collar as 0.09. **(08 Marks)**

OR

10 a. Explain the stresses induced in a screw fastening subjected to static and impact loading. **(06 Marks)**

b. A power screw for a Jack has square threads of proportion $50 \times 42 \times 8$. The coefficient of friction at the threads is 0.1 and at the collar is 0.12. Determine the weight that can be lifted by this jack through a human effort of 400 N, through a hand lever of span 400 mm. **(10 Marks)**

* * * * *