CBCS SCHEME

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18ME52

Fifth Semester B.E. Degree Examination, July/August 2022
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 missing data suitably.

Module-1

1 a. Briefly explain the important mechanical properties of metals. **(06 Marks)**

b. Define standards and codes. **(04 Marks)**

c. A Cantilever beam of rectangular cross section mode of steel has permissible tensile stress of 90 MPa. It is used to support a pulley on which a load of 4.5 kN is suspended. If FOS = 2.5 and the ratio of depth to width of cross section is 2, find the dimensions of the cross section. Refer Fig. Q1 (c). **(10 Marks)**

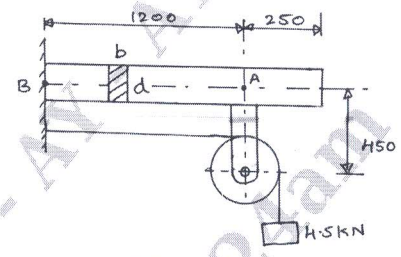

Fig. Q1 (c)

OR

2 a. Explain the reasons for stress concentration in machine members and the methods adopted to relieve the same. **(05 Marks)**

b. A point in a structural member subjected to plane stress is shown in Fig. Q2 (b). Determine the following :

(i) Principal stresses and principal planes.
(ii) Maximum shear stress and the direction of the planes on which it occurs.
(iii) Verify the answer by Mohr's circle method. **(15 Marks)**

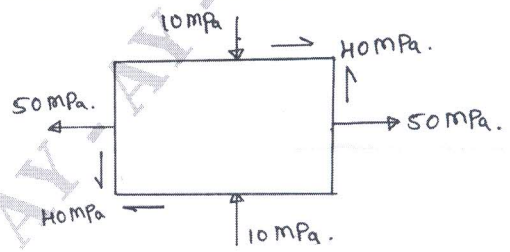

Fig. Q2 (b)

Module-2

3 a. Derive an expression for impact stress in a axial bar of cross section 'A' and length 'L' due to impact of a load 'W' falling from a height 'h'. **(10 Marks)**

b. A steel wire 5 mm diameter is firmly held in clamp from which it hangs vertically. An anvil, the weight of which may be neglected is secured to the wire 2 m below the clamp. The wire is to be tested allowing a weight bared to the slide over the wire to drop freely from 1.5 m above the anvil. Calculate the weight required to stress the wire to 700 MPa, assuming the wire to be elastic up to the this stress. Take E = 210 GPa. **(10 Marks)**

OR

4 a. Explain the terms Fatigue, Fatigue failure and endurance strength. **(06 Marks)**

b. A steel shaft is subjected to a bending moment varies from 100 N-m to 200 N-m and transmits 10 kW at 150 rpm. The torque varies over a range of ±40%. The shaft is made of steel whose yield stress is 400 MPa and endurance stress is 300 MPa. Surface co-efficient factor is 0.9. Size factor is 1.2. FOS is 5. SCF is 1.94. Determine the diameter 'd' based on Soderberg criterion. **(14 Marks)**

Module-3

5 a. Design a shaft to transmit power from an electric motor to a lathe head stock through a pulley by means of a belt drive. The pulley weighs 200 N and is located at 300 mm from the center of bearing. The diameter of the pulley is 200 mm and the maximum power transmitted is 1 kW at 120 rpm. The angle of lap of the belt is 180° and coefficient of friction between the belt and the pulley is 0.3. The shock and fatigue factors for bending and twisting are 1.5 and 2.0. The allowable shear stress in the shaft may be taken as 35 MPa. **(10 Marks)**

b. A hollow shaft of diameter ratio 0.375 is required to transmit 500 kW at 110 rpm, the maximum torque being 20% greater than the mean. The shear stress is not to exceed 60 MPa and angle of twist in a length of 3 m is not to exceed 1.4°. Calculate the shaft diameter if G = 84 GPa. Take $K_t = 1.25$. **(10 Marks)**

OR

6 a. Explain the various types of keys and their applications. **(06 Marks)**

b. In a flange coupling used to connect two co-axial shafts of diameter 80 mm to transmit 60 kW at 200 rpm, 6 bolts of M14×1.5 are used on a bolt circle diameter of 240 mm. The hub diameter is 150 mm and flange thickness is 20 mm. Take key way factor is $\eta = 0.75$. Determine (i) Shear stress induced in shaft (ii) Shear stress induced in bolt. (iii) Shear stress induced in key if allowable bearing stress on the key is 80 MPa. (iv) Shear stress induced in flange **(14 Marks)**

Module-4

7 a. Design a double riveted lap joining of chain type to connect two plates each 20 mm thick. The allowable stress for rivets and plates are 90 MPa in tension, 60 MPa in shear and 150 MPa in crushing. **(10 Marks)**

b. A tie bar in a bridge consists of plate 350 mm wide and 20 mm thick. It is connected by a plate of same thickness by a cover butt joint. Design an economical structural joint, if permissible stresses are 90 MPa in tension, 60 MPa in shear and 150 MPa in compression. **(10 Marks)**

OR

8 a. A plate of 80 mm wide and 10 mm thick is to be welded to another plate by means of two parallel fillet welds. The plates are subjected to a load of 50 kN. Find the length of weld so that maximum stress does not exceed 50 MPa. Consider the joint under static loading and then under dynamic loading. **(10 Marks)**

b. A solid circular shaft 25 mm in diameter is welded to a support by means of a fillet weld as shown in Fig. Q8 (b). Determine the leg dimensions of the weld if the permissible shear stress is 95 MPa. **(10 Marks)**

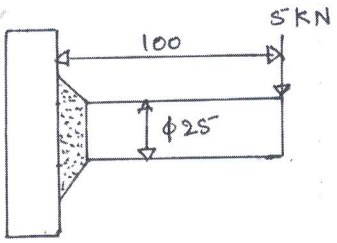

Fig. Q8 (b)

Module-5

9 a. Obtain the expression for torque required to lift the load on a square threaded screw. **(08 Marks)**

b. Design a Knuckle joint to connect two circular rods subjected to an axial tensile force of 50 kN. The rods are coaxial and a small amount of angular movement between their axes is permissible. The design stresses may be taken as 80 MPa in tension, 40 MPa in shear and 80 MPa in compression. **(12 Marks)**

OR

10 a. The jaws of a machine vice weigh 5000 N and are slided by a two start acme thread, 50 mm diameter and 8 mm pitch at a speed of 800 mm/min. The ends of the screw carried a thrust washer of mean diameter 56 mm. The coefficient of thread friction is 0.14. Determine the power of the motor required in 'KW' and the efficiency of the drive. Take $\mu_C = 0.147$. **(10 Marks)**

b. A square threaded power screw has a nominal diameter of 30 mm and a pitch of 6 mm with double threads. The load on the screw is 6 kN and the mean diameter of the thrust collar is 40 mm. The co-efficient of friction for the screw is 0.1 and the collar is 0.09. Determine :
   (i) Torque required to raise and lower the screw with the load.
   (ii) Overall efficiency.
   (iii) Is this screw self-locking. **(10 Marks)**

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