CBCS SCHEME

USN | | | | | | | | | | 15ME54

Fifth Semester B.E. Degree Examination, Aug./Sept.2020
Design of Machine Elements – I

Time: 3 hrs. Max. Marks: 80

Note: **1.** ***Answer any FIVE full questions, choosing ONE full question from each module.***
2. ***Use of Design Data handbook is permitted.***

Module-1

1 a. Draw the stress strain diagram for a ductile material and briefly explain the salient points. **(06 Marks)**

b. What are the factors to be considered for the selection of material for a machine component? **(06 Marks)**

c. Explain the codes and standards used in machine design. **(04 Marks)**

OR

2 a. Define stress concentration. Briefly explain the factors effecting stress concentration. **(06 Marks)**

b. A round rod of diameter 1.2d has semicircular groove of diameter 0.2d. The rod is subjected to a bending moment of 10 kN-m. The material of the rod is C30 steel (σ_y = 294 N/mm^2). Determine the safe value of 'd'. If the factor of safety = 2. **(10 Marks)**

Module-2

3 a. Derive an expression for instantaneous stress due to axial impact. **(06 Marks)**

b. A cantilever beam of width 50 mm, depth 150 mm is 1.5m long. It is struck by a weight of 1000 N that falls from a height of 10 mm at its free end. Determine impact factor, instantaneous maximum deflection, instantaneous maximum stress, instantaneous maximum load. Take E = 206 GPa. **(10 Marks)**

OR

4 A steel cantilever member shown in Fig.Q4 is subjected to a transverse load at its end that varies from 45N (up) to 135N (down) and axial load varies from 110 N (compression) to 450 N (tension). Determine the required diameter at the change of section for infinite life using a factor of safety 2. The strength properties of the material are σ_u = 550 MPa, σ_y = 470 MPa, σ_{-1} = 275 MPa, notch sensitivity index, q = 1.

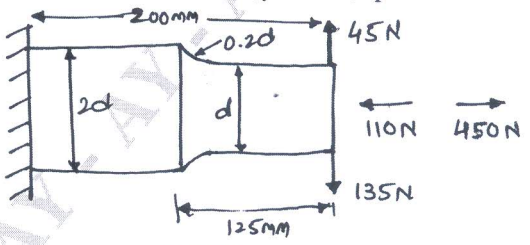

Fig.Q4 **(16 Marks)**

Module-3

5 A mild steel shaft transmits 20 KW at 200 rpm. It carries a central load of 900 N and is simply supported between the bearings 2.5 m apart. Determine the size of the shaft, if the allowable shear stress is 42 MPa and the maximum tensile or compressive stress is not to exceed 56 MPa. What size of the shaft will be required, if it is subjected to gradually applied loads? **(16 Marks)**

OR

6 a. Design a knuckle joint to connect two circular rods subjected to an axial tensile force of 50 kN. The rods are co-axial and a small amount of angular movement between their axes is permissible. The design stresses may be taken as 80 N/mm^2 in tension, 40 N/mm^2 in shear and 80 N/mm^2 in compression. **(08 Marks)**

b. Design a flange coupling to connect the shaft of a motor and centrifugal pump for the following specifications: pump output = 3000 liters/minute, total head = 20 m, pump speed = 600 rpm, pump efficiency = 70%. Select C40 steel (σy = 328.6 MPa) for shaft and C35 steel (σ_y = 304 MPa) for bolts with factor of safety 2. Use allowable shear stress in cast iron flanges equal to 15 N/mm^2. **(08 Marks)**

Module-4

7 a. Briefly explain the types of failure in riveted joints. **(04 Marks)**

b. Design a double riveted butt joint with two cover plates for longitudinal beam of a boiler shell 1.5 m in diameter subjected to steam pressure of 0.95 N/mm^2. Assume joint efficiency as 75%, allowable tensile stress is 90 N/mm^2, crushing stress is 140 N/mm^2 and shear stress is 56 N/mm^2. **(12 Marks)**

OR

8 a. A solid circular shaft 25 mm in diameter is welded to a support by means of a fillet weld as shown in Fig.Q8(a). Determine the leg dimensions of the weld if the permissible shear stress is 95 N/mm^2.

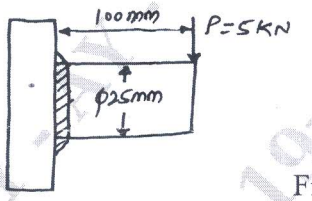

Fig.Q8(a) **(06 Marks)**

b. A bracket is welded to a side column as shown in Fig.Q8(b) with a permissible stress of 80 N/mm^2. Determine the maximum load that the bracket can withstand if the size of the weld is 10 mm.

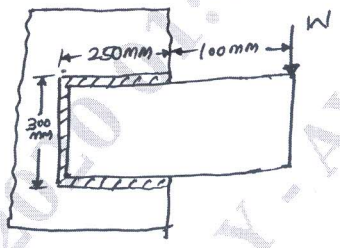

Fig.Q8(b) **(10 Marks)**

Module-5

9 a. Explain the various type of stresses in thread fasteners. **(06 Marks)**

b. A flat circular plate is used to close the flanged end of a pressure vessel of internal diameter 300 mm. The vessel carries a fluid at a pressure of 0.7 N/mm^2. A soft copper gasket is used to make the joint leak proof. Twelve bolts are used to fasten the cover plate onto the pressure vessel. Find the size of bolts so that the stress in the bolts is not to exceed 100 N/mm^2. **(10 Marks)**

OR

10 a. Derive an expression for torque required to lift the load on square threaded screw. **(06 Marks)**

b. A machine slide weighing 20 kN is raised by a double start square threaded screw at the rate of 0.84 m/min. The coefficient of friction for screw and collar is 0.12 and 0.14 respectively. The outside diameter of the screw is 44 mm and pitch is 7 mm. The outside and inside diameters of the collar at the end of the screw are 58 mm and 32 mm respectively. Calculate the power required to drive the slide and efficiency. If the allowable shear stress in the screw is 30 MPa, is the screw strong enough to sustain the load. **(10 Marks)**