U.S.N | | | | | | | | | | |

P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)

Fifth Semester, B.E. - Automobile Engineering

Semester End Examination; Dec - 2019

Design of Machine Elements - I

Time: 3 hrs *Max. Marks: 100*

***Note**: Answer **FIVE** full questions, selecting **ONE** full question from each unit.*

UNIT - I

1 a. Mention the design consideration in designing of machine elements. 5

b. Explain briefly failure of brittle and ductile materials. 5

c. A machine member of 50 mm diameter by 250 mm long supported at one end as a cantilever and other end is subjected to various loads as shown in Fig. 1. Determine the maximum and minimum normal stresses and the maximum shear stress. 10

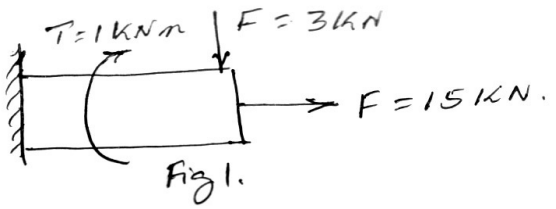


Fig 1.

2 a. Explain any three theories of failure. 6

b. Explain the codes and standards. 5

c. An unknown weight falls through 10 mm on a collar rigidly attached to the lower end of a vertical bar 3 m long and 600 mm^2 in section. If the maximum instantaneous extension is known to be 2 mm, what are the corresponding stress and the value of unknown weight? Take; E = $2x10^5$ N/mm^2. 9

UNIT - II

3 a. What are the causes of stress concentration? What are the methods of reducing stress concentration? 5

b. Write a note on fatigue failure and endurance limit. 5

c. Determine the thickness of a flat rectangular plate as shown in Fig. 2, which has to sustain a load of 250 kN with a factor of safety of 2. Assume the material is of C20 steel. 10

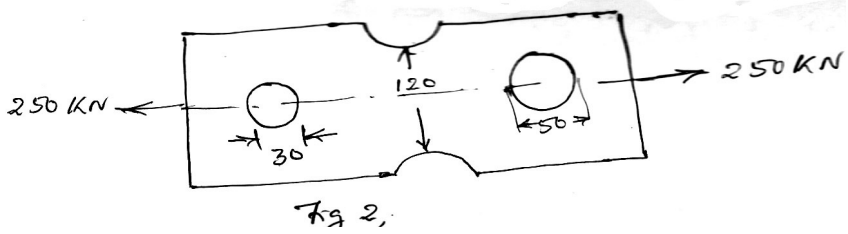


Fig 2.

4 a. Derive Soderberg's equation for variable loads. 6

Contd…2

b. A steel shaft is subjected to a torque which varies from 330 Nm clockwise to 110 Nm counter clock wise and a bending moment at critical section that varies from 440 Nm to − 220 Nm. The shaft is of uniform cross section and no keyway is present. Determine the required shaft diameter .Take σ_u= 550 N/mm^2, σ_y= 410 N/mm^2, σ_{en}= 275 N/m^2, factor of safety = 2, size factor = 0.85, surface factor = 0.62. 14

UNIT - III

5 a. Sketch and explain the different types of keys used in practice. 6

b. Design a Knuckle Joint to connect two mild steel rods subjected to an axial pull of 100 kN. The allowable stress for rods and pins are 100 MPa, 130 MPa and 60 MPa in tension, crcushing and shear respectively. The bending of the pin is prevented by selection of proper fit. 14

6 a. Compare the weight, strength and stiffness of hollow shaft of the same external diameter as that of solid shaft. The inside diameter of the hollow shaft being 2/3rd of the external diameter. Both the shaft has the same material and strength. 6

b. A steel shaft transmitting 25 kW at 350 rpm is supported between two bearings which are 800 mm apart and has keyed to it a pulley and a gear. The power is supplied to the shaft through a pulley of diameter which is located at a distance of 250 mm to the right of left hand bearing. The belt ends are horizontal and the ratio of tension is 2.5. A 200 mm diameter gear of 20° involute teeth is located at 150 mm to the left of right hand bearing delivers power to a gear directly below the shaft. Determine diameter of the shaft by assuming as allowable shear stress of 60 MPa. 14

UNIT - IV

7 a. Briefly explain the classification of riveted Joint. 6

b. A cylindrical pressure vessel with a 1.5 m inside diameter is subjected to internal steam pressure of 1.5 MPa. It is made from steel plate by triple riveted double straps longitudinal butt Joint with equal straps. The pitch of the rivets in outer row is twice the pitch of rivets in inner rows. The rivets are arranged in Zig - Zag pattern. Take efficiency of Joint 80%, σ_c = 80 MPa, τ = 60 MPa, σ_c = 120 MPa. Design the Joint. 14

8 a. A welded connection as shown in Fig. 3 is subjected to an eccentric force of 60 kN in the plane of the welds. Determine the size, if weld of the permissible shear stress for weld is 100 N/mm^2. Assume static condition. 8

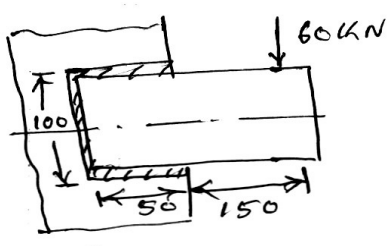


Fig 3

Contd…3

b. A 60 mm diameter solid shaft is welded to a flat plate by 10 mm fillet weld as shown in Fig. 4. Find;

i) The torque that the welded Joint can sustain, if the maximum shear stress in the weld is not to exceed 80 MPa

ii) The bending moment that the welded joint can sustain, if the maximum shear stress in the weld is not to exceed 120 MPa. 6

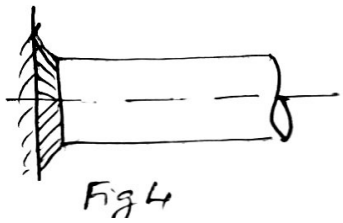


Fig 4

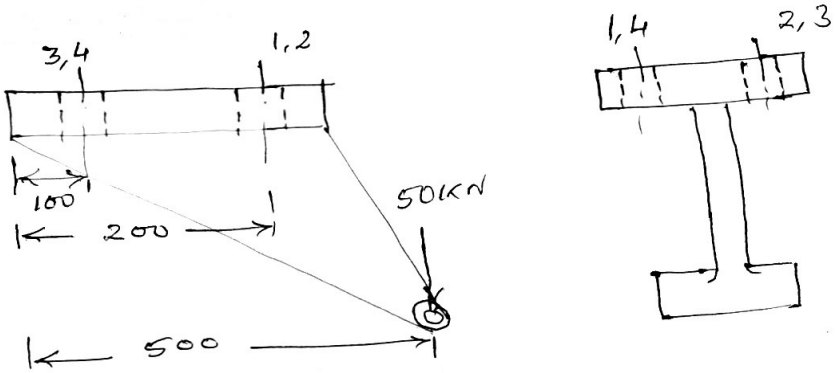
c. What are the advantages and disadvantages of welded joint over riveted Joint? 6

UNIT - V

9 a. Discuss the significance of initial tightening load and the applied load so for as both are concerned. 5

b. Name the different types of Screw thread. Illstrate any one type of screw thread with a diagram. 5

c. A bracket shown in Fig. 5 carries a load of 50 kN. Determine the size of the bolt, if the permissible tensile stress in the bolt material is 200 N/mm^2. 10



10 a. Obtain an equation for the torque requried to lift the load on square thread screw . 6

b. A 50 mm square thread steel screw is used in a screw Jack. The pith of the jack is made of good grade cast iron. The screw is made of C40 annealed steel with $\mu = 0.14$, the thrust collar at the top has an inside diameter of 38 mm and outside diameter of 75 mm. Take μ for collar as 0.24. The load to be lifted by the Jack is 25 kN. 14

Determine;

i) Efficiency of the screw alone

ii) Efficiency of the screw and collar

iii) The pull necessary to operate this Jack

* * *