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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; Feb. - 2021

Design of Machine Elements - I

Time: 3 hrs *Max. Marks: 100*

***Note**: i) Answer **FIVE** full questions, selecting **ONE** full question from each unit.*
ii) Missing data, if any, suitably assume. iii) Design data hand book is permitted.

UNIT - I

1 a. Explain the following: 8
i) Codes and Standard ii) Stress strain diagram

b. A cantilever circular rod has a diameter of 50 mm and 300 mm length. Find out the values of principal stress and maximum shear stress under the following conditions: 12
i) Applying an axial load of 20 kN
ii) Applying 4 kN load at an end, acting downwards creating bending stress
iii) Applying a torque of 1.5 kN-m

2 a. Classify and explain any one of the theories of failure. 6

b. A mild steel shaft is subjected to 3500 N-m of bending moment at its critical point and transmits a torque of 2500 N-m. The shaft is made of steel having yield strength of 231 MPa. Estimate the size of the shaft based on various theories of failure and specify the final size. Take; FOS = 2 and μ = 0.3. 14

UNIT - II

3 a. Define stress concentration and methods of reducing stress concentration. 8

b. A round stepped shaft is made of brittle material C.I. FG 260 and subjected to a bending moment of 15 N-m as shown in Fig. 3(b). The stress concentration factor at the fillet is 1.5. Determine the following: 12
i) Step diameter
ii) Magnitude of stress at fillet
iii) Factor of safety

4 a. What is Endurance limit? What are the factors that modify the Endurance limit approximation? 4

b. A SAE 1025 water quenched steel rod (σ_u = 620.8 MPa, σ_y = 400.1 MPa and σ_{en} = 345.2 MPa) of circular circuit shown in Fig.4b is subjected to a load varying from *P* to *3P*. Determine the value of *P*. The stress concentration factor may be taken as 1.4. Analyze the member at the change of circuits. Use FOS = 3. 16

Contd…2

UNIT - III

5 a. What are the different types of keys? Explain their application. 4

b. Design a cotter joint to carry an axial force of 12 kN. Use the following stress:
Allowable stress in tension and bending = 40 MPa
Allowable stress in crushing = 80 MPa
Allowable shear stress = 32 MPa 8

c. Design a knuckle joint for a tie rod of circular circuits to sustain a maximum tensile load of 70 kN. The ultimate tensile strength of the rod against tension is 420 MPa. The ultimate tensile of shearing stress for the pin materials are 500 MPa and 360 MPa respectively. Take a factor of safety of 6. 8

6 a. Compare hallow shaft with solid shaft for strength, stiffness and weight. 6

b. A shaft of a motor is supported at two points which are 800 mm apart. The armature of the motor can be considered as a uniformly distributed load of 15 N/mm, centrally spread over a length of 500 mm, selecting a suitable material and choosing appropriate value for the factor of safety. Determine the diameter of the motor shaft. The motor develops 15 kN at 1500 rpm. 14

UNIT - IV

7 a. Explain different types of riveted joints and modes of failure in riveted joints. 6

b. Design a double riveted lap joint with Zigzag riveting for 13 mm thick plates. The working stresses to be used are σ_t = 80 MPa, τ = 60 MPa and σ_c =120 MPa. Find the efficiency of the joint. 14

8 a. Explain the design procedure for eccentrically loaded welded joint is bending. 6

b. A 80 mm wide of 12 mm thick plate subjected to axial tensile load is welded to a vertical support by a single transverse fillet weld and a double parallel fillet weld shown in Fig. 8b. The maximum tensile and shear stress in the weld are 100 MPa and 70 MPa respectively. Find the length of each parallel weld, if the joint is subjected to, 14
i) Fatigue loading ii) Static loading

UNIT - V

9 a. The cylinders head of a reciprocating air compressor is held in place by 10 bolts. The total joint stiffness is 4 times the total bolt stiffness. Each bolt is tightened to an initial tension of 5 kN. The total external forces acting to separate the joint is 20 kN. Find the size of the bolt so that the stress in the bolt is not to exceed 100 MPa. 8

b. A cylinder head is fastened to the cylinder of a compressor using 6 bolts of M20 size. Bolt material is C20. The maximum fluid pressure is 3.5 MPa, cylinder diameter is 75 mm. A soft gasket is used. Assuming the initial tension required in each bolt as 40 kN, determine the FOS. 12

Contd…3

10 a. What is a self locking and overhauling in power screws? 6

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 thread collor is 40 mm. The coefficient of friction for the screw is 0.1 and the collor is 0.09. Determine; 14

i) Torque required to raise the screw against the load

ii) Torque required to lower the screw with the load

iii) Overall efficiency

iv) Is the screw self-locking?

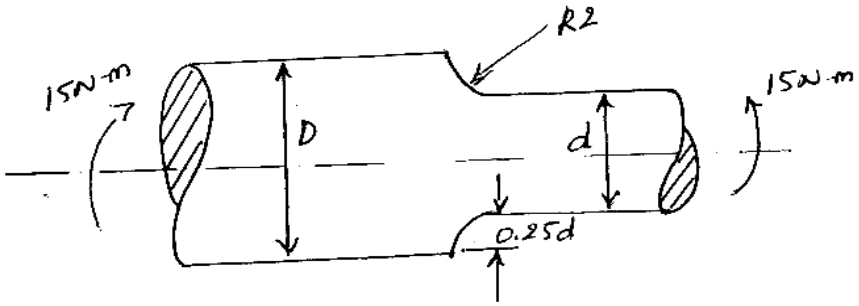

Fig : 3b

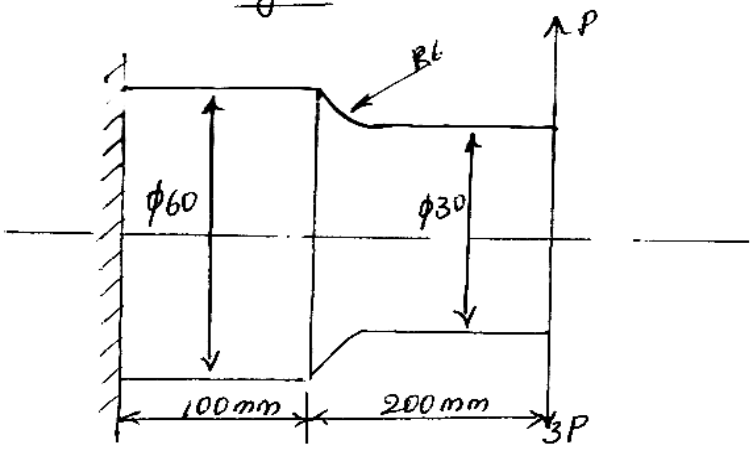

Fig 4b

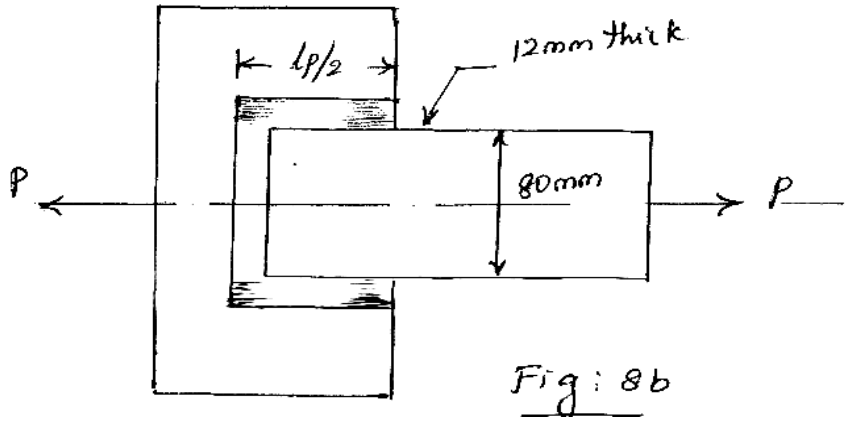

Fig : 8b

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