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

(An Autonomous Institution affiliated to VTU, Belgaum)

Fifth Semester, B.E. - Industrial and Production Engineering

Semester End Examination; Dec. - 2015

Design of Machine Elements

Time: 3 hrs *Max. Marks: 100*

***Note**: i) Answer **FIVE** full questions, selecting **ONE** full question from each **unit**.*
ii) Assume suitable missing data if any.
iii) Use of machine Design Data Hand Book is permitted.

UNIT - I

1 a. What is meant by static load? Give example. 4

b. Define factor of safety. Explain its importance in design. 6

c. A round rod of 50 mm diameter is to sustain an axial load of 20 kN (tensile) and a twisting moment of 1.5 kN-m. The rod is made of C40 steel. Determine the factor of safety from the following theory of failure; i) Max principal stress theory ii) Max. Shear stress theory. 10

2 a. Define stress concentration factor. Explain the different methods of reducing stress concentration. 6

b. Determine the maximum stress induced in the grooved shaft shown in Fig. Q 2(b). If it is subjected to i) an axial load of 40 kN ii) A bending moment of 400 N-m iii) A twisting moment of 500 N-m. Take stress concentration into account. 14

UNIT - II

3 a. Derive the Good man relationship. 10

b. A medium carbon steel rod is subjected to a reversed axial load of 200 kN. Determine the required diameter of the rod using a factor of safety 2. The endurance limit and ultimate strength of the material of the rod are 250 MPa and 550 MPa. 10

4 a. Define endurance Limit and explain different types of cyclic loading. 10

b. A SAE 2340 steel shaft is subjected to a torsional load that will vary from 400 N-m to 100 N-m. Determine the required diameter of the rod using a factor of safety 1.5. 10

UNIT - III

5. A shaft is supported by two bearings 1.5 meters apart. A 20º involute gear of 175 mm pitch circle diameter is keyed to the shaft at a distance of 400 mm to the left of right hand bearing and is driven by a gear directly behind the shaft. The direction of rotation of the gear is such, that tangential force acts vertically downwards. A 600 mm diameter pulley is keyed to the shaft at a distance 600 mm to the right of left hand bearing and drives a machine pulley with a horizontal belt directly behind it. The ratio of tensions in belt is 3 to 1. The drive transmits 45 kW at 330 rpm. Taking $C_m = C_t = 1.5$, Determine the diameter of the shaft if $\tau_{Allowable} = 40$ MPa. 20

Contd… 2

6 a. Prove that hollow shaft is stronger and stiffer than solid shaft of same length, weight and material. 10

b. The tangential force on a 12 mm x 12 mm x 50 mm square key is 30 kN. Determine;
i) Shear stress in the key ii) Crushing stress in the key
iii) Factor of safety if the material has an ultimate shear stress of 350 $N/mm^{2.}$ 10

UNIT - IV

7 a. Define efficiency of a Riveted jointed. 2

b. Explain the different modes of failure in Riveted joint. 6

c. It is required to design longitudinal riveted joints for a boiler of inner diameter 1.5 m of the steam pressure in the boiler is 2 N/mm^2, take; σ_t = 80 N/mm^2, P = 60 N/mm^2 , σ_C = 120 N/mm^2. 12

8 a. Determine the length of each parallel fillet weld for a 80 mm wide and 12 mm thick pate subjected to a Tensile load and is welded to a vertical support as shown in Fig. Q 8(a) by a single transverse and double paralleled fillet weld. The values of σ_{max} = 100 MPa ρ_{max} = 70 MPa. 10

b. Determine the required fillet size for the bracket shown in Fig. Q 8 (b). If the allowable shear stress in the weld is 75 MPa. 10

UNIT - V

9 . A reciprocating machine running at 360 rpm is driven by 12 kW, 1440 rpm motor through a $14\frac{1}{2}^0$ involute gear. The centre distance is 250 mm. the pinion is made of heat treated cast steel and the gear is of untreated cast steel. Assume light shock condition and 8 hours per day operation. Design the gears and check the gears for wear: 20

$(\sigma_d)_{gear}$ =137.35 MPa

$(\sigma_d)_{pinion}$ = 191.29 MPa.

10 a. Design a helical compression spring to carry a load of 500 N with a deflection to carry a load of 500 N with a deflection of 20 mm. the allowable shear stress in the spring material is 350 MN/m^2 and the modulus of rigidity is $82.7x10^3$ MN/m^2. The spring index is 6. 10

b. A load of 2 kN is dropped axially on a load coiled helical spring from a height of 250 mm. The spring has 20 effective turns and is made of 25 mm diameter wire. The spring index is 8. Find the maximum shear stress induced in the sparing and the amount of compression produced take G = 82.7 GN/m^2. 10

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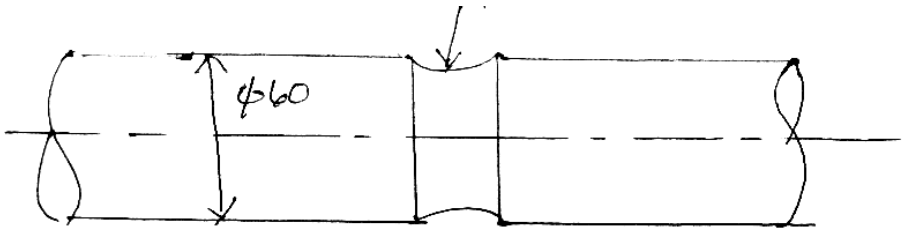

Fig q 2(b)

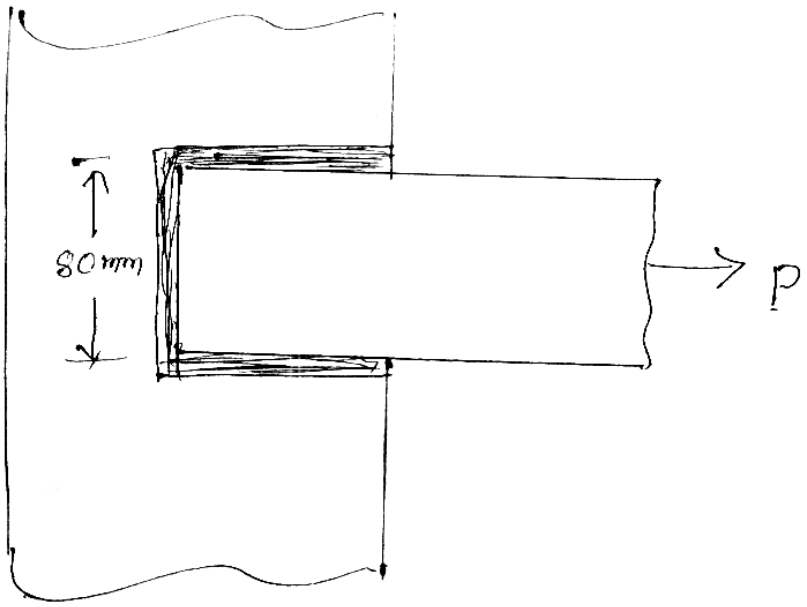

Fig q 8(a)

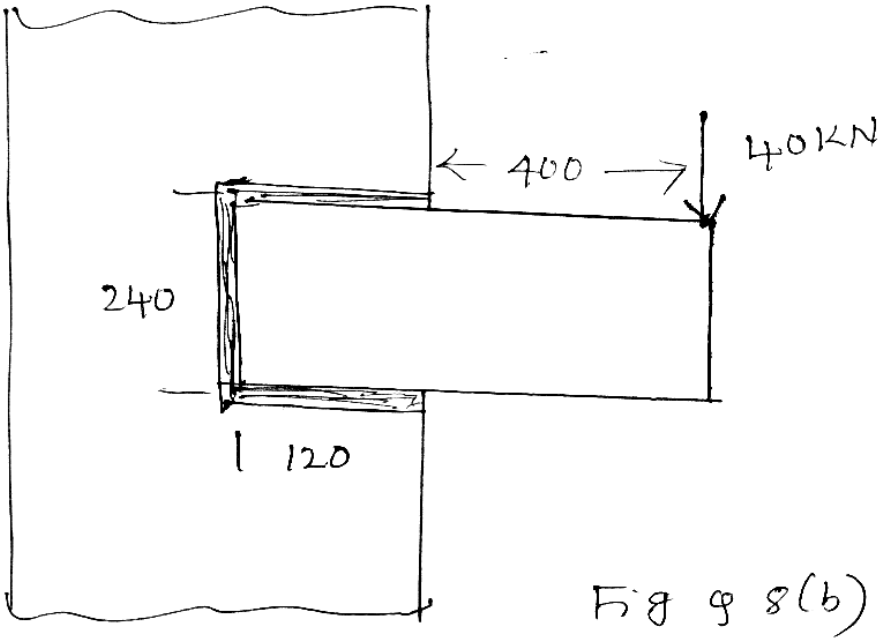

Fig q 8(b)

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