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

(An Autonomous Institution affiliated to VTU, Belagavi)

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

Semester End Examination; Dec. - 2019

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. Define factor of safety and list the factors which are used in design. 6

b. Derive an expression for bending loading. When a horizontal beam belt under vertical loads? 6

c. A rectangular plate of 60 mm width is subjected to a tensile load of 9810 N. It has a hole of diameter 12 mm drilled at its centre. Find the thickness, stress concentration factor, if the material of the plate is SAE 1045 annealed steel. Use factor of safety 2. 8

2 a. Explain the following theories of failures:
i) Maximum principal strain theory ii) Maximum total strain energy theory 6

b. Derive maximum Principal stress equation using Mohr's circle of stresses. 6

c. The load on a bolt consists of an axial pull of 10,000 N and a transverse shear load of 5000 N. The permissible tensile stress at the elastic limit is 100 N/mm^2 and $\mu = 0.3$. Find the diameter of the bolt on the basis of; i) Maximum principal strain theory ii) Maximum strain energy theory. 8

UNIT - II

3 a. With figure, explain the stress cycles. 8

b. Define fatigue stress concentration factor. 4

c. Determine the thickness of a 120 mm wide uniform plate for safe continuous operation if the plate is to be subjected to a tensile load that has a maximum value of 25,000 N and a minimum value of 10,000 N. The properties of the plate material are given to be σ_{en} = 2250 N/mm^2, σ_{yp} = 3000 N/mm^2 and net yield point = 1.5. 8

4 a. Derive Soderberg's equation considering factor of safety. 10

b. A piston Rod of a steam engine is subjected to a maximum reversed Axial load of 10,000 N. It is to be made of steel having an ultimate stress of 9000 N/mm^2. Design the piston rod assuming that there is no stress concentration. Take a factor of safety 2. The size and surface correction factor can be taken as 0.85 and 0.8 respectively. 10

UNIT - III

5 a. Explain the processing of Caulking and Fullering with neat sketches. 8

b. A lap joint with triple rivet is required for fastening plate of thickness 20 mm each. Design the joint completely and determine the efficiency of the joint. Assume the following safe stress: Z = 50 N/mm^2, σ_t = 80 N/mm^2. 12

Contd…2

6 a. Derive an expression for a long fillet weld subjected to Torsion. 8

b. Determine the size of the weld for the eccentric connection shown in the sketch. The allowable shear stress in the fillet weld using Mild steel bare electrode can be taken as 80 N/mm^2. 12

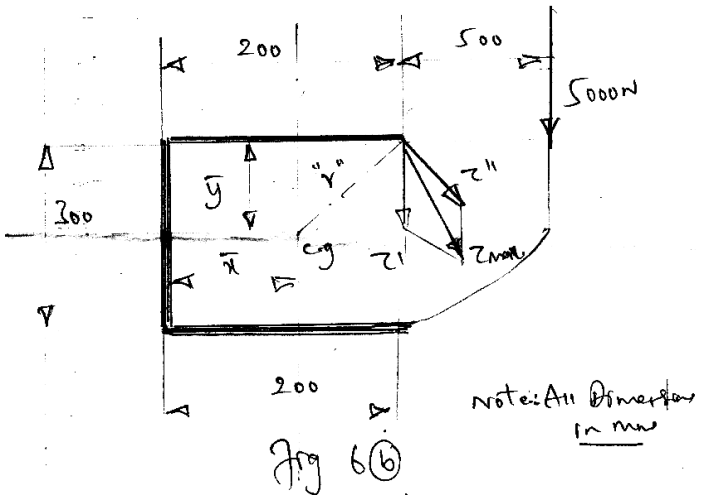

Fig 6(b)

UNIT - IV

7 a. Show that $F_t = \sigma_d.c_v.\ b.\pi.m.y.$ 8

b. A pair of spur gears has to be designed to transmit 11.5 kW power at 1500 rpm of the pinion. The desired velocity ratio is 3:1. The centre distance is to be 400 mm. The pinion should have 20 teeth of 20° tooth form. Both the gears are made of forged steel 0.3%C. Service conditions are with minor shock and intermittent service. Design gears with static loading only. 12

8 a. Derive an expression for stresses in Helical spring of circular cross section in static loading only. 10

b. A Helical spring (coil) is subjected in service conditions to a load of 3000 N. The axial compression of spring due to load is 8 mm. Considering the space limits the spring index may be 6. Design the spring if $\tau_{all} = 450$ N/mm^2. 10

UNIT – V

9 a. Derive equations of a shaft subjected to combined bending and twisting moment. 10

b. Find the diameter of a solid steel shaft to transmit 20 kW at 200 rpm. The ultimate shear stress for the steel may be taken as 360 N/ mm^2 and a factor of safety 8. If a hollow shaft is to be used in place of a solid shaft. Find the inside diameter and outside diameter, when the ratio of inside diameter to outside diameter is 0.5. 10

10 a. With a neat sketch, explain the friction in journal bearing. 8

b. A 75 mm long full journal bearing of diameter 75 mm supports a load of 12 kN on a Journal running at 1800 rpm. Assuming d/c ratio of 1000 and an oil viscosity of 0.01 kg/ms at the operating temperature, determine; 12

i) F by Mckee's equation

ii) Heat generated based on Mckee's equation

iii) Probable surface temperature of bearing

Using Lasche's equation assuming that heat generated is all dissipated in still air at 20°C.

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