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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 - 2017/Jan - 2018

### Design of Machine Elements

Time: 3 hrs

Max. Marks: 100

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

#### UNIT - I

- 1 a. Explain stress concentration in static loading and dynamic loading. 6  
 b. A rectangular plate of 60 mm with 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 SAE1045 Annealed steel. Use factor of safety 2. 14
- 2 a. Derive maximum principal stress equations using Mohr's circle of stress. 8  
 b. The load on a bolt consists of an axial pull of 10,000 N and trasverse shear load of 5000 N. The permissible tensile stress at the elastic limit is  $100 \text{ N/mm}^2$  and  $\mu = 0.3$ . Find the diameter of the bolt on the basis of;  
 (i) Maximum principles strain theory 12  
 (ii) Maximum strain energy theory.

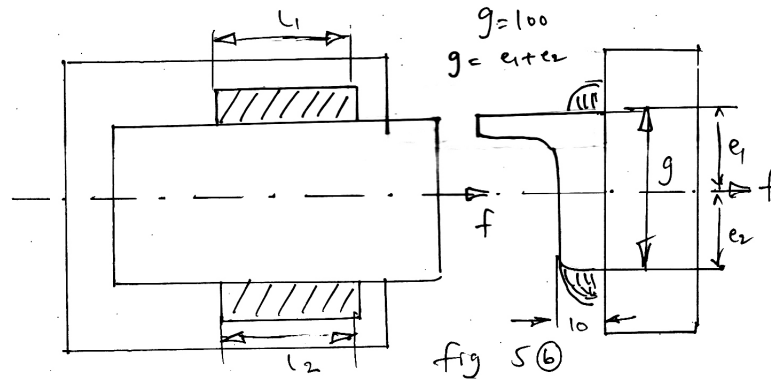
#### UNIT - II

- 3 a. Derive Sodenberg equation considering stress concentration and factor of factors. 8  
 b. Determine the thickness of a 120 mm wide uniform plate for safer 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  $\sigma_{en} = 2,250 \text{ N/mm}^2$ ,  $\sigma_{yp} = 3000 \text{ N/mm}^2$  and  $N$  at yield point = 1.5. 12
- 4 a. What are the different factors affecting fatigue strength? 6  
 b. A piston rod of a steam engine is subjected to a maximum renewed axial load of 10,000 N. It is to be made of steel having an ultimate stress of  $900 \text{ N/mm}^2$ . Design the piston rod assuming that there is no stress concentration. Take a factor of safety 2. The size and surface connection factor can be taken as 0.85 and 0.8 respectively. 14

#### UNIT - III

- 5 a. Define an expression for the length of the weld  $L_1$  and  $L_2$  considering an angle which is fixed to the plate. 8

- b. A 50×100×10 mm angle is welded on to a Gussett plate. The load to be withstand is 1,96,200 N. Allowing a shear stress of 84 N/mm<sup>2</sup>, for the weld material, determine the length of the welds. 12



- 6 a. Draw the arrangement of double Riveted lap joint (Zig-Zag) with 2 views. 8
- b. A lap joint with triple rivet is required for fastening plates of thickness 20 mm each. Design the joint completely and determine the efficiency of the joint, by assuming following safe stress value  $\sigma_t = 80 \text{ N/mm}^2$ ,  $\tau = 50 \text{ N/mm}^2$ . 12

UNIT - IV

7. A pair of spur gears has to be designed to transmit 15 HP at 1500 rpm of the pinion. The designed 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 0.3C. Service factors are with minimum shock and intermittent service. Check the gears for diagnose and wear load. 20
- 8 a. Describe an expression for axial deflection of the spring. 8
- b. A helical coil spring 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  $\tau_{all} = 450 \text{ N/mm}^2$ . 12

UNIT - V

- 9 a. Derive an expression for the diameter of the shaft considering ASME code of practice. 10
- b. A circular solid shaft is subjected to a bending moment of 29,43,000 N-mm and a torque of 98,10,000 N-mm. The shaft is made of C-45 steel having ultimate tensile stress of 686 N/mm<sup>2</sup> and an ultimate shear stress of 490 N/mm<sup>2</sup>. Assuming a factor of safety = 6, determine the diameter of the shaft. 10
- 10 a. Explain with sketches the mechanism of fluid form lubrication in bearings. 10
- b. A journal bearing 75 mm long supports a load of 7.3 kN on a 50 mm diameter journal rotating at 750 rpm. The diametric clearance is 0.07 mm. What should be the viscosity of the oil, if the operating temperature of the bearing surface is limited to 75° when it is in still air at 20°C? 10