



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 bent 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: 6
- i) Maximum principal strain theory ii) Maximum total strain energy theory
- 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 $\sigma_{en} = 2250 \text{ N/mm}^2$, $\sigma_{yp} = 3000 \text{ N/mm}^2$ 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: $Z = 50 \text{ N/mm}^2$, $\sigma_t = 80 \text{ N/mm}^2$. 12

