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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. - 2014

Design of Machine Elements

Time: 3 hrs

Max. Marks: 100

**Note:** i) Answer any **FIVE** full questions, selecting at least **TWO** full questions from each part.

ii) Use of Machine Design Hand Book is permitted.

### PART - A

- 1.a. Explain the different methods of reducing stress concentration. 8
- b. Determine the maximum stress induced in the grooved shaft shown in Fig Q1(b) It is subjected to
- i) An axial load of 40 KN 12
- ii) A Bending moment of 400 N-m and
- iii) A twisting moment of 500 N-m take the stress concentration into account.
- 2 a. What is S-N diagram explain its importance. 6
- b. Differentiate between low cycle fatigue and high cycle fatigue. 4
- c. A SAE 2340 water quenched 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
- $\sigma_{ult} = 413.8 \text{ MPa}$ ,  $\sigma_{en} = 144.12 \text{ MPa}$
- 3 a. Design a rigid flange coupling to transmit 18 kW at 1440 rpm. The allowable shear stress in the cast iron flange is 4 MPa. The shaft and keys are made of C40 steel. Use ASME code for design of shaft and key. 10
- b. Design a socket and spigot type cotter joint to connect two rods subjected to a steady axial pull of 100 kN. The material used for spigot, socket and cotter is C40 steel. Take factor of Safety as 4 for based on the yield strength and yield strength for C40 steel is  $328.6 \text{ N/mm}^2$ . 10
- 4 a. Prove that a hollow shaft is stronger and stiffer than a solid shaft of same length, weight and material. 8
- b. A steel shaft of 2 m long supported between bearings running at 1000 rpm carries a  $20^\circ$  involute spur gear of pitch diameter 200mm at its mid point. The gear delivers 20 kW power to its mating gear located directly above the shaft. If the shaft material selected has an allowable shear stress of 40 MPa. Determine the diameter of the shaft. 12
- Assume the loads are steady.

### PART - B

- 5 A Reciprocating machine running at 360rpm is driven by 12 kW, 1440 rpm motor through a  $14\frac{1}{2}^\circ$  involute gear. The center distance between the drive being 250 mm. The pinion is made of heat treated cast steel of 450 BHN and the gear is of untreated cast steel. Assume light shock 20

- i) Module, face width and the number of teeth on each gear
- ii) Check the gears for wear

Allowable stress for cast steel heat treated is 191.295 MPa, Allowable stress for untreated cast steel is 137.35 MPa.

- 6 a. A double riveted Lap joint (Chain type) is to be made of 10mm plates. Design the riveted joint if the safe working stress in tearing of plates, shear and crushing are 124 MPa, 93 MPa and 165 MPa respectively. 8
- b. Define efficiency of riveted joint and modes of failure in riveted joint. 6
- c. A plate 100 mm wide and 10mm thick is to be welded with another plate by means of transverse fields at the ends. Determine the length of the weld if the maximum tensile stress is not to exceed 90 MPa. 6
- 7 a. A railway wagon weighing 40 kN and moving with a speed of 10 km/ hour has to be stopped by four butter springs in which the maximum compression allowed is 200 mm. Find the number of turns in each spring of mean diameter 150 mm. The diameter of the spring wire is 25 mm. take  $b = 82.7 \times 10^3 \text{ MN} / \text{m}^2$  10
- b. A semi elliptical laminated spring made of a 9 leaves is 1.1 m long between the centers of eye. Two of the leaves extend full length of the spring. The leaves are held together by a band 80 mm wide. If the spring is to carry a load of 5.4 kN and the permissible stress for the spring material is not to exceed 400 MPa. find width and thickness of leaves when 10
  - i) Leaves are not stressed initially
  - ii) Leaves are stressed initially.

The deflection of the spring is not to exceed 70 mm. The modulus of Elasticity for the spring material is 206.8 Gpa.
- 8 a. What is bearing Modulus and explain its importance. 6
- b. A single-row deep groove ball bearing is to carry a radial load of 2.5 kN and a thrust load of 1.5 kN. The service imposes light shock and the bearing is to operate 40 hours per week for 4 years. The speed of the shaft is 900 rpm. Select the bearing. 14

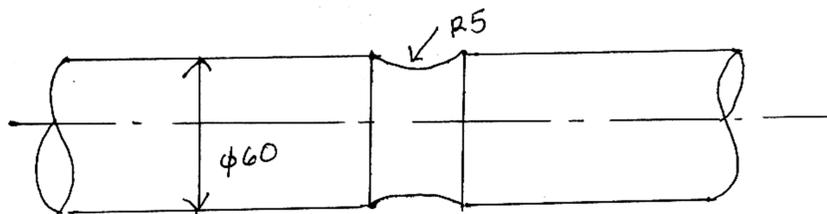


Fig. Q1(b)

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