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

(An Autonomous Institution affiliated to VTU, Belgaum)

Fifth Semester, B.E. - Automobile Engineering

Semester End Examination; Dec. - 2015

Design of Machine Elements - I

Time: 3 hrs

Max. Marks: 100

- Note:** i) Answer **FIVE** full questions, selecting **ONE** full question from each **unit**.
 ii) Missing data, if any, may be suitably assumed and stated.
 iii) End of design data book is permitted

UNIT - I

- 1 a. Explain the Design procedure. 5
 b. Differentiate between the normal stress and the shear stress. 3
 c. A machine member 60 mm diameter is subjected to an axial tensile load of 18 kN, a transverse load of 3 kN and a turning moment of 1.2 kN as shown in Fig. (1). Determine the max. principal and shear stress induced in the member. 12
- 2 a. Derive an expression for stress induced in a rod due to the axial impact of a weight W dropped from a height 'h' on to a collar attached at the free end of the rod. What is the stress due to suddenly applied Load? 8
 b. A SAE 1045 steel rod of 80 mm diameter is subjected to a bending moment of 3 kN-m and torque T. Taking factor of safety as 2.5. Find the maximum value of torque 'T' that can be carried safely by rod according to, 12
 i) Maximum normal stress theory
 ii) Maximum shear stress theory.

UNIT - II

- 3 a. What is stress concentration? What are the means of reducing stress concentration? 6
 b. A stepped shaft is subjected to a transverse load of 8 kN as shown in Fig. 2. Determine the diameter of the shaft based on factor of safety of 2. 14
- 4 a. What is endurance limit? What are the factors that modify the endurance limit approximation? 6
 b. A round rod of diameter 1.2 d has semicircular groove of diameter 0.2 d. This rod is to sustain a twisting moment that fluctuates between 2.5 kN-m and 1.5 kN-m together with a bending moment that fluctuates between +2 kN-m and -1 kN-m. Take $\sigma_y = 300$ MPa, $\sigma_u = 450$ MPa and f.o.s. = 2.5. Find suitable diameter of rod. 14

UNIT - III

- 5 a. What are different types of keys? Explain their applications. 6
- b. Design a rigid flange coupling to transmit 18 kW at 1440 rpm. The allowable shear stress for CI flange is 4 MPa. The shafts keys and bolts are made of annealed steel having allowable shear stress of 93 MPa. Allowable crushing stress for key = 186 MPa. 14
- 6 a. Compare hollow shaft with solid shaft for strength, stiffness and weight. 6
- b. The hollow shaft is supported between bearings placed 1.2 m apart. A 600 mm diameter pulley is mounted at a distance of 200 mm to the right of left hand bearing and this drives a pulley directly below it with the help of a belt having maximum tension of 2 kN. Another pulley of 400 mm diameter is placed 200 mm to the left of right bearing and is drives with the help of a motor and belt which is placed at 45° to vertical and downward towards the observer. The angle of contact for both pulleys is 180° and coefficient of friction is 0.25. Determine the suitable diameter for hollow shaft having diameters ratio of 0.5. The allowable tensile and shear stresses are 63 MPa and 42 MPa respectively and assume heavy shocks. 14

UNIT - IV

- 7 a. Explain different modes of failure in riveted joints. 6
- b. Design the main dimensions for longitudinal and circumferential joints for a boiler whose inner diameter is 1.7 m and steam pressure of 2.058 MPa. The rivet in double shear will have an effective resistance not greater than 87.5% over that in shear. 14
- 8 a. Explain the design procedure for eccentrically loaded welded joint in bending. 8
- b. Determine the load carrying capacity of a welded joint loaded as shown in Fig. 3. The size of the weld is 12 mm and allowable shear stress in weld is 81 MPa. 12

UNIT - V

- 9 a. Derive an expression for the secondary shear in bolts in terms of applied load and eccentricity of the load. 8
- b. A M10 bolt connects two circular plates with outside to inside diameter ratio 2.0 and the inside diameter 1mm more than the diameter of the bolt. The thickness of the plate is 20 mm and the material of the bolt and plate are same. The external load on the joint is 8 kN. If the allowable stress in the bolt is not to exceed 100 MPa, what is the initial tension to be applied to the bolt? 12
- 10 a. What is self locking and overhauling in power services. 6
- b. A square threaded power screw has a normal diameter of 44 mm and a pitch of 7 mm with double threads. The load on the screws 6 kN and mean diameter of the thrust washer is 50 mm. Coefficient of friction is 0.12 determine ; 14

- i) Torque required to raise the load
- ii) Torque required to lower the load
- iii) Efficiency and
- iv) Is the screw is of self locking type?

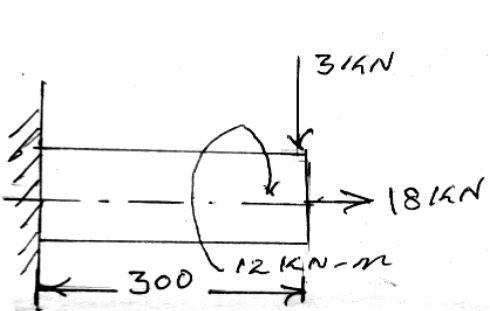


Fig 1

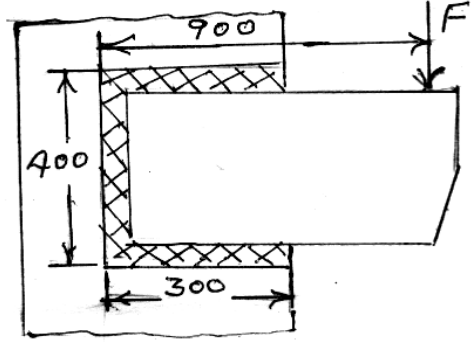


Fig 3

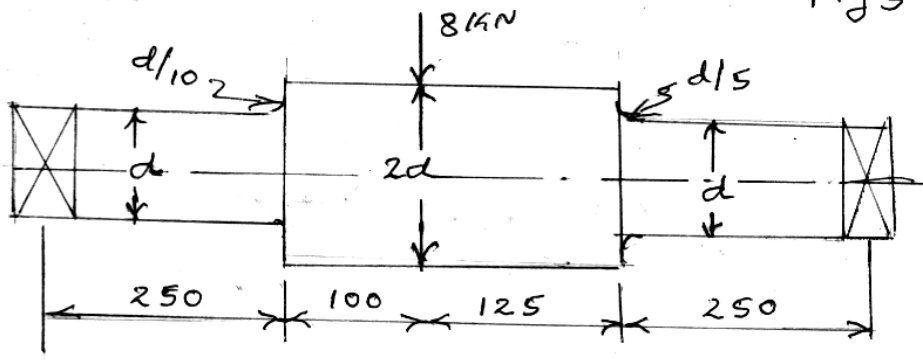


Fig 2
