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Time: 3 hrs.

10AU52

Fifth Semester B.E. Degree Examination, July/August 2021

**Design of Machine Elements – I**

Max. Marks:100

**Note: 1. Answer any FIVE full questions.  
2. Use of design data hand book is permitted.**

- 1 a. List and explain the procedure for designing a machine. (06 Marks)
- b. With the neat block diagram, explain the classification of engineering materials and also the factors on which choice of material depends. (06 Marks)
- c. A tension member is formed, by connecting two wooden scantling with glue, each 50mm × 100mm at their ends, which are cut at an angle of 60° as shown in Fig Q1(c). The member is subjected to a pull F. Calculate the safe value of F, if the permissible normal and shear stress in the glue use are 3N/mm<sup>2</sup> and 2N/mm<sup>2</sup> respectively.

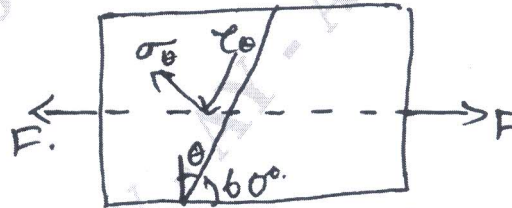


Fig Q1(c)

(08 Marks)

- 2 a. A material has a maximum yield strength in tension and compression of  $\sigma_y = 100\text{MPa}$ . Find the FOS for the following theories using the following stresses –  $\sigma_1 = 70\text{MPa}$ ,  $\sigma_2 = 70\text{MPa}$ ,  $\sigma_3 = 0$ .
  - i) Maximum normal stress theory
  - ii) Maximum shear stress theory
  - iii) Distortion emerges theory. (06 Marks)
- b. Define stress concentration factor and list and explain the methods for reducing the stress concentration along with sketches (any 4 methods). (06 Marks)
- c. A 50mm diameter steel rod supports a 9.0kN load and in addition is subjected to a torsional moment of 100N-m as shown in Fig Q2(c). Determine the maximum tensile and maximum shear stress.

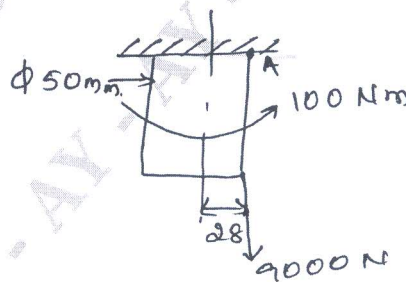


Fig Q2(c)

(08 Marks)

- 3 a. List the factors on which endurance limit of the material depends. (06 Marks)
- b. A piston is subjected to a maximum reversed axial load of 110kN. It is made of steel having an ultimate stress of 900N/mm<sup>2</sup> and the surface is machined. The average endurance limit is 50% of the ultimate strength. Take the size correction coefficient as 0.85 and FOS = 1.75. Determine the diameter of the rod. (14 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.  
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

- 4 a. Design a socket and spigot type cotter joint to sustain an axial load of 100kN the material selected for the joint has the following design stress.  $\sigma_t = 100\text{N/mm}^2$ ,  $\sigma_c = 150\text{N/mm}^2$  and  $\tau = 60\text{N/mm}^2$ . (10 Marks)
- b. A rectangular sunk key 14mm wide  $\times$  10mm thick  $\times$  75mm long is required to transmit 1200N-m torque from a 50mm diameter solid shaft. Determine whether the length is sufficient or not if the permissible shear stress and crushing stress are limited to 56MPa and 168MPa respectively. (10 Marks)
- 5 A machine shaft turning at 600rev/min is supported on bearings 750mm apart, 15kW is supplied to the shaft through a 450mm pulley located 250mm to the right of the right bearing. The power is transmitted from the shaft through a 200mm spur gear located 250mm to the right of the left bearing. The belt drive is at an angle of  $60^\circ$  above the horizontal. The pulley weighs 800N to provide some flywheel effect. The ratio of the belt tensions is 3:1. The gear has a  $20^\circ$  tooth form and mesh with another gear located directly above the shaft. If the shaft material selected has an ultimate strength of 500MPa and a yield point of 310MPa, determine necessary diameter using  $K_b = 1.5$  and  $K_t = 1.0$ . (20 Marks)
- 6 a. A triple threaded power screw is used in a screw jack, has a nominal diameter of 50mm and at pitch of 8mm. The threads are square shape and the length of the nut is 48mm. The screw jack is used to lift a load of 7.5kN. The coefficient of friction at the threads is 0.12 and collar friction is negligible. Calculate :  
 i) Principal shear stress in screw rod  
 ii) Transverse shear stress in the screw and nuts (10 Marks)
- b. A machine slide weighing 20kN is raised by a double start square threaded screw at the rate of 0.84m/min. The coefficient of friction for screw and collar is 0.12 and 0.14 respectively. The outside diameter of screw is 44mm and pitch is 7mm. The outside and inside diameters of the collar at the end of the screw are 58mm and 32mm respectively. Find the power required to drive slide. If the allowable shear stress in the screw is 30MPa is the screw strong enough to sustain the load. (10 Marks)
- 7 a. List the assumption made while designing the riveted joints. (06 Marks)
- b. A double riveted lap joint is to be made between 9mm plates. If the safe working stresses in tension, crushing and shear are  $80\text{N/mm}^2$ ,  $120\text{N/mm}^2$  and  $60\text{N/mm}^2$  respectively, design the riveted joint. (14 Marks)
- 8 a. Explain the classification of welding process and the advantages of welded joints. (10 Marks)
- b. Two plates are joined by means of fillet – welds as shown in Fig Q8(b). The leg dimensions of the welds is 10mm and the permissible shear stress at the throat cross section is  $75\text{N/mm}^2$ . Determine length of each weld.

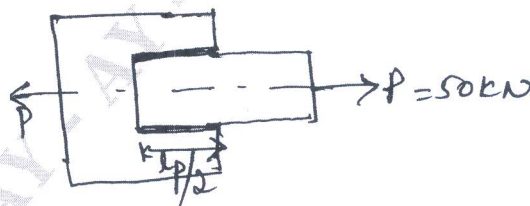


Fig Q8(b)

(10 Marks)

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