TME-502

Roll No.

Odd Semester Examination, 2019-20
B.Tech-Mechanical Engineering (Semester-5th)
Machine Design-I

Time: 3:00 Hrs.

Max. Marks: 100

Total no. of printed pages: 3

Note: All questions are compulsory:

$4 \times 5 = 20$

Q1. **Attempt any four of the following**

a) With a suitable example, explain the significance of preferred numbers in the design of product.

b) What are the factors to be considered for the selection of materials for the design of machine elements? Discus them.

c) Discuss the important non-metallic materials used in engineering practices.

d) What is the fatigue failure of material? Explain the mechanism of such failures.

e) Explain the BIS system of designation of steel.

f) Explain different theories of failure with expression.

$2 \times 10 = 20$

Q2. **Attempt any two of the following**

(a) At a critical section in a shaft, the bending stress = 60 MPa and torsional shear stress = 40 MPa. Determine the factor of safety according to (i) Max. normal stress theory and (ii) Max. Shear stress theory. Yield stress of shaft material is 300 MPa and Poisson's ratio is 0.3.

(b) A cantilever beam made up of steel 40 C8 (S_{ut} = 600 N/ mm², S_{yt} = 380 N/ mm²) is shown in figure 1. The force P acting at free end varies from -50 N to +150N. The expected reliability is 90 % and factor of safety is 2. The notch sensitivity factor at the fillet is 0.9. Determine the diameter d at the fillet cross section.
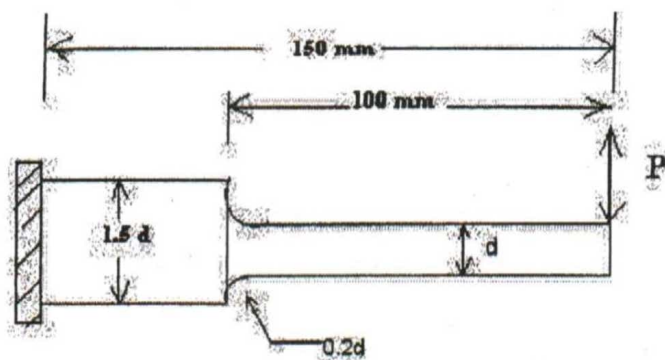
P.T.O

Fig. 1

(c)

(i) Explain the modified Goodman Diagram for design.

(ii) What do you understand by stress concentration? Explain various methods to minimize stress concentration the mechanical component.

Q3. **Attempt any two:** 2×10 = 20

a)

(i) Design a cast iron protected type flange coupling to transmit 18 KW at 950 rpm from a motor to a pump. The service factor is 1.35. Shear stress for shaft, bolt and key material is 45 MPa. Crushing stress for bolt and key is 90 MPa, shear stress for cast iron is 9 MPa.

(ii) Design a rectangular key for a shaft diameter of 75 mm, the shearing and crushing stresses for key materials are 50 MPa and 75 MPa respectively.

b) A shaft is supported by two bearings placed 1 meter apart, a 600 mm diameter pulley is mounted at a distance of 300 mm to the right of left hand bearing and this drives a pulley directly below it with the help of belt having maximum tension of 2250 N. another pulley 400 mm diameter is placed 200 mm to the left of right-hand bearing and is driven with the help of electric motor and belt, which is placed horizontally to the right. The angle of contact for both the pulley is 180⁰ and coefficient of friction is 0.24. Determine the suitable diameter for a solid soft. Allowable tensile stress 63 MPa and Allowable shear stress is 42 MPa. Assume that torque on one pulley is equal to the torque on the other pulley.

c) A plate 75 mm wide and 12.5 mm thick is joined with another plate by sigle transverse weld and a double parallel fillet weld as shown in fig.2 the maximum tensile and shear stresses are 70 MPa and 56 MPa respectively. Find the length of each parallel fillet weld, if the joint is subjected to static loading.
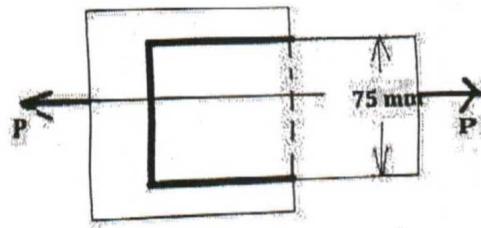
Fig. 2

$2 \times 10 = 20$

Q4. **Attempt any two:**

a) A helical compression spring of a mechanism is subjected to an initial pre-load of 50 N and maximum force during load cycle is 300 N. The wire diameter is 5 mm, while spring index is 5. The spring is made of oil hardened and tempered steel wire of grade-SW (Sut=1440 N/mm²). Determine factor of safety against fluctuating load.

b) (i) Derive the load-stress equation and load deflection equation of a leaf spring without nipping.
   (iii) Explain Nipping in leaf springs with suitable expression.

c) Describe in detail with neat sketches the design procedure of screw jack.

$2 \times 10 = 20$

Q5. **Attempt any two:**

a) Explain Need Analysis and Need based Design.

b) What is Design by Evolution? Explain with Example.

c) Explain different steps involved in design. Also explain different stages of Product Development?