



**DESIGN OF MACHINE MEMBERS-I**  
(Mechanical Engineering)

**Maximum Marks: 70**

Date: 26.06.2023 Duration: 3 hours

- Note:**
1. This question paper contains two parts A and B.
  2. Part A is compulsory which carries 20 marks. Answer all questions in Part A.
  3. Part B consists of 5 Units. Answer any one full question from each unit which carries 10M.
  4. Each question carries 10 marks and may have a, b, c, d as sub questions.

Part-A

All the following questions carry equal marks

(10x2M=20 Marks)

- 1 Write the difference between ductile and brittle materials.
- 2 Write about factor of safety under static loading and fluctuating loads.
- 3 What is notch sensitivity? Also define Theoretical stress concentration factor.
- 4 Write short notes on Soderberg and Goodman design criteria with diagram.
- 5 Explain caulking and why is it necessary?
- 6 Differentiate between welding joint and riveted joint.
- 7 Explain the effect of key way on strength of shaft.
- 8 Write the advantages of key.
- 9 Define equivalent bending and twisting moment.
- 10 Define torsional and lateral rigidity.

Part-B

Answer All the following questions.

(10MX 5=50Marks)

- 11 A. Define simple stress and give few examples of machine components subjected to simple stress. (3M)  
B. Determine the diameter of a ductile steel bar subjected to an axial tensile load of 40kN and a torsional moment of  $16 \times 10^5$  N.mm. Use factor of safety of 1.5,  $E=2 \times 10^5$  MPa and  $S_y = 210$  MPa. (7M)

OR

- 12 A. Explain which three theories of failure are applicable to ductile materials. (5M)  
B. Prove that for maximum shear stress theory  $S_{ys} = 0.5 S_y$  for pure shear and  $S_{ys} = 0.577 S_y$  for pure shear with energy of distortion theory. (5M)

- 13 A. Derive an expression for Goodman relation. (5M)  
B. A uniform bar having a machined surface is subjected to an axial load varying from 400kN to 150 kN. The material of the bar has  $S_u = 630$  MPa,  $K_c = 0.7$  and  $K_t = 1.42$ . Find the diameter  $d$  of the rod using  $F.S = 1.5$  (5M)

OR

- 14 A shaft is subjected to a torque varying between 5000 N-m to 10000 N-m. The stress concentration factor due to the keyway is 2.5.  $S_u = 500$  MPa,  $S_e = 0.5 S_u$ ,  $S_y = 300$  MPa, endurance correction factor = 0.6, size correction factor = 0.8 and surface correction factor = 0.82. Find the diameter of the shaft using  $F.S = 2$ . (10M)

15 Derive the expression for the maximum stress induced in weld subjected to torsional loading. (10M)

OR

16 A steam engine cylinder of 300mm effective diameter is subjected to a steam pressure of 1.5 N/mm<sup>2</sup>. The cylinder head is connected by means of 8 bolts having yield strength of 320 MPa, and endurance limit of 240 MPa. The bolts are tightened with an initial preload of 1.5 times that of steam load. A soft copper gasket is used to make the joint leak proof. Assuming a fatigue stress concentration factor of 1.4, and factor of safety of 2; determine the size of the bolts required. (10M)

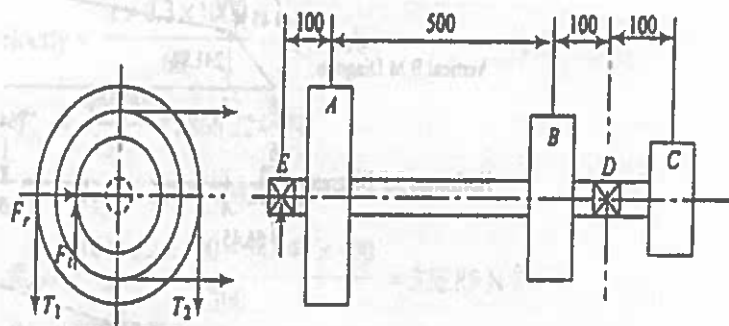
17 A. Where and why the woodruff key is used? (3M)

B. A 30kW power is transmitted at 240 rpm, from 40 mm diameter shaft, by means of two Kennedy keys of 12 x 12 mm cross-section. Determine the length of the keys. For the keys, take permissible shear stress as 60 MPa, and crushing stress as 90 MPa. (7M)

OR

18 Design a cotter joint to connect a piston rod to the crosshead. The maximum steam pressure on the piston rod is 35 KN/mm<sup>2</sup>. Assuming that all the parts are made of the same material having the following permissible stresses:  $\sigma_t = 50$  MPa;  $\tau = 60$  MPa and  $\sigma_c = 90$  MPa. (10M)

19 A shaft is subjected to loads as shown in Fig. Gear C is connected to the other gear such that 50 kW is transmitted at 100 rpm. The pressure angle of the involute gear teeth is 20°. The ratio of belt tensions for pulley A is 2:1, the diameter of pulley being 750 mm. the sprocket B is 500 mm diameter with negligible drive is 20 kW, the remaining being transmitted by the belt drive. Find diameter of the shaft if F.S=3,  $K_m = 1.5$ ,  $K_t = 1.2$  and  $S_y = 350$  MPa for shaft material. (10M)



OR

20 Design a rigid muff coupling. Use C.I for the muff. The power transmitted is 25kW at 300 rpm.  $S_{ut} = 200$  MPa, F.S = 6, use 30C8 steel for the shaft consider  $S_y = 330$  MPa and F.S = 4. (10M)

