

Roll No.

Total No. of Pages : 03

Total No. of Questions : 09

**B.Tech. (ME) (Sem-5)**  
**DESIGN OF MACHINE ELEMENTS**

Subject Code : BTME-502-18

M.Code : 78248

Date of Examination : 19-06-2024

Time : 3 Hrs.

Max. Marks : 60

**INSTRUCTIONS TO CANDIDATES :**

1. SECTION-A is COMPULSORY consisting of TEN questions carrying TWO marks each.
2. SECTION-B contains FIVE questions carrying FIVE marks each and students have to attempt any FOUR questions.
3. SECTION-C contains THREE questions carrying TEN marks each and students have to attempt any TWO questions.

**SECTION-A**

**1. Write briefly :**

- a) Enumerate the general considerations in machine design.
- b) Explain the concepts of tearing, bearing and shearing.
- c) Define endurance strength.
- d) What type of stresses are induced in shafts?
- e) List the basic assumptions used in the theory of hydrodynamic lubrication.
- f) List the advantages and disadvantages of Worm Gear drives.
- g) What is the curvature effect in a helical spring? How does it vary with spring index?
- h) How does the function of a brake differ from that of a clutch?
- i) Why are square threads preferable to V-threads for power transmission?
- j) Under what condition a flexible coupling is used?

## SECTION-B

2. Find the diameter of a solid steel shaft to transmit 20 kW at 200 r.p.m. The ultimate shear stress for the steel may be taken as 360 MPa and a factor of safety as 8.  
  
If a hollow shaft is to be used in place of the solid shaft, find the inside and outside diameter when the ratio of inside to outside diameters is 0.5.
3. Explain in detail the procedure followed in designing a journal bearing.
4. Design a spring for a balance to measure 0 to 1000 N over a scale of length 80 mm. The spring is to be enclosed in a casing of 25 mm diameter. The approximate number of turns is 30. The modulus of rigidity is 85 kN/mm<sup>2</sup>. Also calculate the maximum shear stress induced.
5. A multi-disc clutch has three discs on the driving shaft and two on the driven shaft. The inside diameter of the contact surface is 120 mm. The maximum pressure between the surface is limited to 0.1 N/mm<sup>2</sup>. Design the clutch for transmitting 25 kW at 1575 r.p.m. Assume uniform wear condition and coefficient of friction as 0.3.
6. What do you understand by fatigue failure? Write a note on Gerber design criterion.

## SECTION - C

7. A motor shaft rotating at 1500 r.p.m. has to transmit 15 kW to a low speed shaft with a speed reduction of 3:1. The teeth are 14.5° involute with 25 teeth on the pinion. Both the pinion and gear are made of steel with a maximum safe stress of 200 MPa. A safe stress of 40 MPa may be taken for the shaft on which the gear is mounted and for the key. Design a spur gear drive to suit the above conditions. Also sketch the spur gear drive. Assume starting torque to be 25% higher than the running torque.
8.
  - a) A plate 100 mm wide and 12.5 mm thick is to be welded to another plate by means of parallel fillet welds. The plates are subject to a load of 50 kN. Find the length of the weld so that the maximum stress does not exceed 56 MPa. Consider the joint first under static loading and then under fatigue loading.
  - b) The cylinder head of a steam engine is subjected to a steam pressure of 0.7 N/mm<sup>2</sup>. It is held in position by means of 12 bolts. A soft copper gasket is used to make the joint leak-proof. The effective diameter of cylinder is 300 mm. Find the size of the bolts so that the stress in the bolts is not to exceed 100 MPa.

9. a) What are flexible couplings and what are their applications? Illustrate your answer with suitable examples and sketches.
- b) An electric motor driven power screw moves a nut in a horizontal plane against a force of 75 kN at a speed of 300 mm / min. The screw has a single square thread of 6 mm pitch on a major diameter of 40 mm. The coefficient of friction at screw threads is 0.1. Estimate power of the motor.

**NOTE : Disclosure of Identity by writing Mobile No. or Making of passing request on any page of Answer Sheet will lead to UMC against the Student.**