

Register No.: Name:

SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

SIXTH SEMESTER B.TECH DEGREE EXAMINATION (S), AUGUST 2023

ROBOTICS AND AUTOMATION

(2020 SCHEME)

Course Code : 20RBT302

Course Name: Design of Machine Elements

Max. Marks : 100

Duration: 3 Hours

- **Use of approved design data book is permitted**
- **Missing data, if any, may be suitably assumed**

PART A

(Answer all questions. Each question carries 3 marks)

1. What is design process? Explain the steps involved in the design process.
2. Explain fatigue loading and its effects on materials.
3. What is the importance of thread standards in threaded joints?
4. Discuss the different types of welded joints.
5. List the factors that need to be considered while selecting springs.
6. What is the critical speed of a shaft?
7. Explain at least two different types of gear tooth failures.
8. What are the advantages and limitations of V-belt drives?
9. What is Sommerfeld Number?
10. List the different modes of lubrication for bearings and state their key characteristics.

PART B

(Answer one full question from each module, each question carries 14 marks)

MODULE I

11. a) What is the importance of standards and codes in engineering design? (4)
b) Determine the diameter of a circular rod made of ductile material (10) with fatigue strength of 250 MPa and tensile yield strength of 400 MPa. The member is subjected to a varying axial load from $F_{\min} = -200$ kN to $F_{\max} = 500$ kN and has a fatigue stress concentration factor = 1.9. Use factor of safety as 1.5.

OR

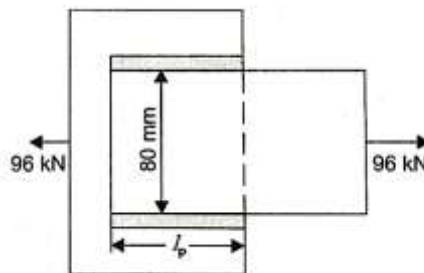
12. a) What is the purpose of the factor of safety in engineering design? (4)
 b) A weight of 600 N drops through a height of 20 mm and impacts the center of 300 mm long simply supported circular cross-section beam. Find the diameter of the beam and the maximum deflection, if the allowable stress is limited to 90 MPa. Neglect the inertia effect and take $E = 200$ GPa. (10)

MODULE II

13. a) How does initial tension affect the behavior of bolted joints? (4)
 b) The cylinder head of a steam engine is subjected to a steam pressure of 0.7 MPa. 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 the cylinder is 300 mm. find the size of the bolt so that the stresses in the bolt is not to exceed 100 MPa. (10)

OR

14. a) What are some common types of loads that can act on fillet welds, and how do they affect the weld strength? (4)
 b) An 80 mm wide, 12 mm thick plate carrying an axial load of 96 kN is welded to a support as shown. The following tensile and shear stress in the weld are 110 MPa and 75 MPa respectively. Find the length of each parallel fillet weld. (10)



MODULE III

15. Design a closed coil helical spring to have a mean diameter of 125 mm and a spring rate of 75 N/mm. The total axial force is 9 kN and the allowable shear stress is 400 MPa. Take $G = 84$ GPa. (14)

OR

16. Design a shaft to transmit power from an electric motor to a lathe head stock through a pulley by means of a belt drive. The pulley weighs 200 N and is located at 300 mm from the centre of the bearing. The diameter of the pulley is 200 mm and the maximum power transmitted is 1 kW at 120 rpm. The angle of lap of the belt is 180° and the coefficient of friction between the belt and pulley is 0.3. The shock and fatigue factors for bending and twisting are 1.5 and 2.0. The allowable shear stress in the shaft may be taken as 35 MPa. (14)

MODULE IV

17. Design a spur gear drive required to transmit 55 kW at 800 rpm of the pinion. The speed ratio is to be 3:2:1. The teeth are to be 20° full depth involute. (14)

OR

18. Select the type and number of V-belts required to drive a crusher, which works 8 hours a day. The power transmitted is 65 kW. The motor shaft runs at 900 rpm and carries a pulley of 250 mm diameter, the crusher shaft rotates at 300 rpm and the center distance is 700 mm. Determine the pitch length of the belt. (14)

MODULE V

19. A single-row deep groove ball bearing is subjected to a radial force of 8 kN and a thrust force of 3 kN. The shaft rotates at 1200 rpm. The expected life L_{10h} of the bearing is 20000 h. The minimum acceptable diameter of the shaft is 85 mm. Select a suitable ball bearing for this application. (14)

OR

20. Design a journal bearing for a centrifugal pump running at 1200 rpm. Diameter of the journal is 100 mm and load on the bearing is 15kN. Take $l/d = 1.5$, bearing temperature 50° and ambient temperature 30° . Find whether artificial cooling is required. (14)
