

Register No.: Name:

SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

SIXTH SEMESTER B.TECH DEGREE EXAMINATION (R), MAY 2023 ROBOTICS AND AUTOMATION

(2020 SCHEME)

Course Code : 20RBT302

Course Name: Design of Machine Elements

Max. Marks : 100

Duration: 3 Hours

(i) Use of approved design data book is permitted

(ii) Missing data if any may be suitably assumed

PART A

(Answer all questions. Each question carries 3 marks)

1. Discuss about the steps in the design process.
2. Define endurance limit and list factors affecting endurance limit.
3. Determine the safe tensile load for the following bolts assuming a safe tensile stress of 65 MPa. a) M12 b) M20 c) M30
4. Explain the different types of welded joints with sketches.
5. Discuss the various classification of springs.
6. What is the critical speed of a shaft?
7. Give an account on different modes of failure of gear teeth.
8. List the advantages of V-belts over flat belts.
9. What are the desirable properties of bearing materials?
10. Explain the objectives and classification of Lubrication.

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) Find the diameter of a rod subjected to torque of varying between 200Nm anticlockwise and 400Nm clockwise direction. The rod is made up of C45 steel. Take the factor of safety as 2. (10)

OR

12. a) What is meant by fluctuating stress? What are the types of fluctuating stress? Explain (4)

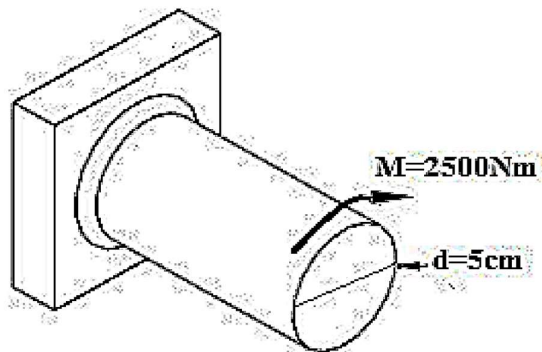
- b) A pulley is keyed to a shaft midway between two bearings. The shaft (10)
is made of cold drawn steel for which the ultimate strength is 550 MPa and yield strength is 400 MPa. The bending moment at the pulley varies from -150Nm to +400Nm as the torque on the shaft varies from -50 Nm to +150 Nm. Obtain the diameter of the shaft for an indefinite life. The fatigue stress concentration factors in bending and in torsion are 1.6 and 1.3 respectively. Take the following values, Factor of safety =1.5, Load correction factors= 1.0 in bending and 0.6 in torsion, Size effect factor =0.85, Surface effect factor =0.88.

MODULE II

13. a) How screw threads are designated? (4)
b) A bolted joint is formed for a pressure vessel in which the bolt is (10)
tightened with an initial preload of 7kN. The external load on bolt varies from 0 to 9 kN. If the gasket factor is 0.33 find out the size of the bolt. Take yield stress & endurance stress for bolt material as 260N/mm² and 130N/mm². Assume a factor of safety 3 and stress concentration factor of 2.8.

OR

14. a) Enumerate the importance of throat thickness in the design of (4)
welded joints
b) A circular shaft of 5cm in diameter is welded to the support by (10)
means of circumferential fillet weld as shown. It is subjected to a torsional moment of 2500 N-m. Determine the size of weld, if permissible shear stress in the weld is limited to 14.27 kg/mm².



MODULE III

15. A railway wagon weighing 3 tons is moving with a velocity of 3 m/s. (14)
It is brought to rest by two buffer springs of diameter 200 mm. The maximum deflection allowed is 160 mm. The allowable shear stress in spring material is 600 MPa. Take $G = 84\text{ GPa}$. Design the spring.

OR

16. A shaft is supported by bearings 600 mm apart. It carries a pulley of diameter 500 mm; at 250 mm to the right of left bearing and another pulley of diameter 380 mm; at 130 mm to the right of the right bearing. The belt drive in the left pulley is vertically downward while that on the right pulley is horizontal. The permissible shear stress is not to exceed 42 MPa. The maximum tension in the smaller pulley is not to exceed 5.5 kN. Find the diameter of the shaft. (Coefficient of friction is 0.3 and angle of contact is 180°). (14)

MODULE IV

17. A compressor receives power through a pair of spur gears. The compressor shaft runs at 350 rpm while the motor shaft runs at 1450 rpm, delivering 40 kW power. The power transmission is with moderate shock and the drive is to operate 10 hours per day. Pinion is made of steel C-40 heat treated and gear is made of cast steel. Design the spur gear set. (14)

OR

18. a) Enumerate the advantages and disadvantages of a flat belt drive. (4)
 b) Design a V-belt drive for the following specifications. Power transmitted is 22 kW, speed of the driving wheel is 1450 rpm, speed of the driven wheel is 400 rpm, center distance should not exceed 2500 mm, and the service of the equipment is 15 hrs/day. (10)

MODULE V

19. a) Enumerate the advantages of Rolling contact Bearing. (4)
 b) Design a rolling contact bearing for a compressor used to support a radial load of 2500N and an axial load of 1500N. The expected life of bearing is 5 years at the rate of 40 hours per week. The bearing is rotating in a shaft of 50 mm diameter at 1000 rpm. (Assume one year is having 52 weeks) (10)

OR

20. a) Derive Petroff's equation stating the important assumptions. (4)
 b) A full journal bearing of diameter 75 mm and a length of 125 mm is to support a load of 20 kN at the shaft speed of 1000 rpm. The bearing temperature is to be limited to 77°C . Design the journal bearing. Also calculate the amount of artificial cooling required and the minimum oil film thickness. (10)
