

Register No.: Name:

SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

SIXTH SEMESTER B.TECH DEGREE EXAMINATION (R,S), MAY 2024

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 are the various steps in design process?
2. What is the importance of preferred numbers? Find out the numbers of the R5 basic series from 1 to 10.
3. A pressure vessel with 250 mm internal diameter is subjected to 2 MPa pressure. Cover plate of vessel is fastened by 6 bolts of size M25. The joint is made leak proof by means of soft copper gasket. Find the stress induced in bolt.
4. Discuss the different types of welded joints.
5. Discuss the various classification of springs.
6. A mild steel shaft is transmitting 70kW at 180rpm. Find out the diameter required, if the allowable stress is limited to 38 MPa and angle of twist not to exceed 1 degree in a length of 20 diameters. Take $G = 80\text{GPa}$.
7. Define the following terms associated with gear;
i) Pitch circle, ii) Circular pitch, iii) Module
8. What are the advantages and disadvantages of V- belt?
9. List the properties of a good lubricant.
10. Explain hydrodynamic theory of lubrication.

PART B

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

MODULE I

11. a) Explain the importance of Standards and Codes in design. (4)
b) A circular beam of 150 mm diameter is simply supported over a span of 2 m. A load of 15 kN is dropped on the middle of the beam from a height of 10 mm. Find the maximum instantaneous deflection and stress induced in the beam. Take $E = 2 \times 10^5 \text{ MPa}$. (10)

OR

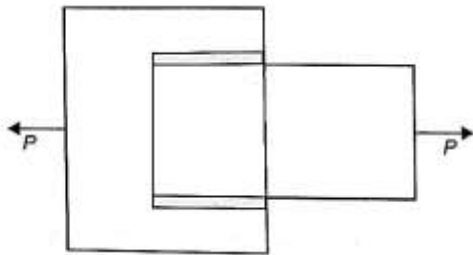
12. a) Distinguish between Impact and Fatigue loading. (4)
 b) A shaft is made of steel subjected to varying bending moment from 100Nm to 400Nm, and a variable torsional moment from 70Nm to 170Nm. Determine the diameter of shaft, if the material properties are; ultimate stress = 540MPa, yield stress = 400MPa, endurance strength = 200 MPa. Take factor of safety of 2. (10)

MODULE II

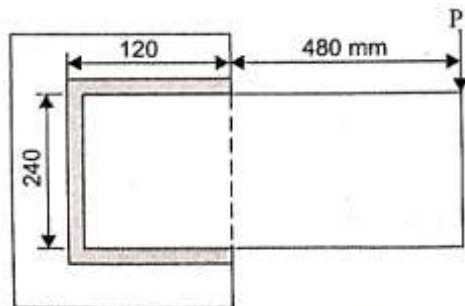
13. a) Explain various terms associated with screw thread with neat sketch. (6)
 b) A cover plate of pressure vessel is fastened by 4 bolts. The inner diameter of vessel is 125 mm and subjected to a pressure of 8MPa. Take yield stress of bolt material = 320MPa and factor of safety =2. Determine the size of bolt for a leak proof joint for the following cases; i) metal to metal joint ii) a gasket joint (8)

OR

14. a) A 10 mm thick plate is welded to another plate by two parallel welds to carry 30kN load as shown in figure. Determine the length of weld required if the load is static. Take maximum shear stress = 75MPa. (4)



- b) A plate is welded and loaded eccentrically as shown in figure. If the permissible shear stress is 80 MPa, determine the maximum load that the bracket can withstand. Take size of weld = 10mm. (10)



MODULE III

15. Design a closed coil helical spring that deflects 30 mm under a load of 600 N. The diameter of each coil is 10 times that of wire and maximum shear stress is not to exceed 350 MPa. Take $G = 84 \text{ GPa}$. (14)

OR

16. A 1.5m long shaft is supported at ends and a 150 mm diameter pulley, (14)
weighing 750N, is located at its mid span. The shaft transmits a power
of 25kW at 100rpm through this pulley. The ratio of belt tension is 2.5.
Find the diameter of shaft if the permissible shear stress is 54 N/mm^2 .
Also find the twist in the shaft. Take; $G = 80 \text{ GPa}$, $C_m = C_t = 1.5$.

MODULE IV

17. Design spur gear that operates 8 to 10 hours per day sustaining (14)
medium shock and transmits 18 kW power from a shaft rotating at 900
rpm to a parallel shaft rotating at 300 rpm. Assume a 20° full depth
involute tooth profile with 31 teeth on pinion. The material of gear is
Cast steel, 0.2%C untreated and that for pinion is C40 steel, untreated.
Check design for dynamic load and wear load. Take load factor $C =$
 522.464 N/mm , load stress factor $K = 0.279 \text{ N/mm}^2$. Suggest suitable
hardness also.

OR

18. V-Belt is used to transmit 80 kW between two shafts at 1 meter (14)
distance. Driver pulley of 250 mm diameter is rotating at 1100 rpm,
driving the driven shaft at 400 rpm. The angle of groove is 35° and
coefficient of friction between belt and pulley rim is 0.25. Calculate the
number of belts required and the length of belt if, the area of belt
section is 420 mm^2 , permissible stress is 2 MPa, and density of belt
 1000 kg/m^3

MODULE V

19. Design a full journal bearing subjected to 6 kN at 1000 rpm. The (14)
journal is of hardened steel, bearing is of babbitt material and oil used
is SAE40. Take operating temperature as 70°C and ambient
temperature as 30°C . Also determine the amount of artificial cooling
required.

OR

20. a) Distinguish between Ball bearing and Journal bearing. (6)
b) A single row deep groove ball bearing is subjected to a radial force (8)
of 6 kN and a thrust force of 4 kN. The shaft rotates at 1000 rpm.
The expected life of the bearing is 18000 hr. The minimum
acceptable diameter of the shaft is 85 mm. Select a suitable ball
bearing for this application.
