Register No.: ..... Name: .....

SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

SEVENTH SEMESTER B.TECH DEGREE EXAMINATION (R), DECEMBER 2023
MECHANICAL ENGINEERING
(2020 SCHEME)

Course Code : **20MET401**

Course Name: **Design of Machine Elements**

Max. Marks : **100** **Duration: 3 Hours**

Use of design data book is permitted
Missing data may be suitably assumed

(Answer any ONE question from each module.
Each question carries 20 marks)

MODULE I

1. a) What is the definition and purpose of a line shaft, counter shaft, and flexible shaft in the context of mechanical systems and machinery? (3)

   b) A shaft is supported by two bearings placed 1 m apart. A 600 mm diameter pulley is mounted at a distance of 300 mm to the right of left hand bearing and this drives a pulley directly below it with the help of a belt having maximum tension of 2.25 kN. Another pulley 400 mm diameter is placed 200 mm to the left of right hand bearing and is driven with the help of electric motor and belt, which is placed horizontally to the right. The angle of contact for both the pulleys is 180° and $\mu = 0.24$. Determine the suitable diameter for a solid shaft allowing working stress of 63 MPa in tension and 42 MPa in shear for the material of the shaft. Assume that the torque on one pulley is equal to that on the other pulley. (17)

OR

2. a) What are the materials commonly used for manufacturing belts? (3)

   b) A 50 kW, 1200 rpm squirrel cage motor is used to drive a punch press. The motor pulley is of 350 mm diameter and that the driven pulley is 1050 mm in diameter. The center distance is 2.5 m. Design a flat belt drive, assuming a service factor of 1.2. (17)

MODULE II

3. a) Differentiate between single plate clutch and multi plate clutch. (4)

   b) Design a single plate clutch having both sides effective from the following data: (16)

Power transmitted = 30 kW; speed of shaft = 1500 pm; allowable lining pressure = 0.147 MPa; maximum diameter of the clutch = 300 mm; service factor = 1.5; number of springs = 9; compression of spring during engagement = 2.5 mm.

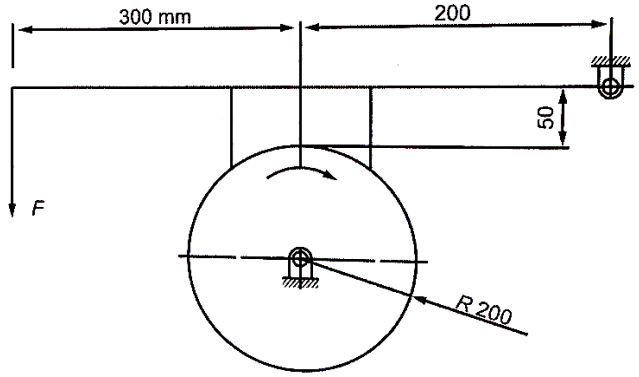
OR

4. a) Write short notes on Disc Brakes. (3)

b) A single block brake with a torque capacity of 250 N-m is shown in Fig. 6.19. The brake drum rotates at 100 rpm and the coefficient of friction is 0.35. Calculate:

i. The actuating force and the hinge-pin reaction.
ii. The rate of heat generated during the braking action and
iii. The dimensions of the block, if the intensity of pressure between the block and brake drum is 1 MPa.

The length of the block is twice the width. (17)



MODULE III

5. a) Discuss the different lubrication regimes, and elaborate on the conditions under which each regime is typically encountered in mechanical systems. (4)

b) Design a journal bearing to withstand a load of 5886 N. Speed of the journal is 1000 rpm. The journal is made of hardened steel and bearing is made of babbit. Operating temperature is 70 °C and ambient temperature is 30 °C. Check the design for thermal equilibrium and also determine the power loss at the bearing. The lubricant used is of grade SAE 40, l/d = 1.5. (16)

OR

6. a) How does the Stribeck curve help in understanding the friction and lubrication behavior of materials in various mechanical applications? (4)

b) 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 (16)

diameter of the shaft is 75 mm. Select a suitable ball bearing for this application.

MODULE IV

7. Specify the details of a spur gear to transmit 20 kW at 1200 rpm. The teeth are of 20° full depth involute system, having 16 teeth on pinion and a speed ratio of 3:1. Assume that the starting torque is 20% more than the mean torque. (20)

OR

8. The following data refers to the design of a helical gear drive:
   i. Power transmitted 34 kW at 2800 pm of pinion
   ii. Speed ratio 4.5, number of teeth on pinion 18
   iii. Helix angel 25°, pressure angle = 20° stub
   iv. Material for both pinion and gear is medium carbon steel whose allowable stress may be taken as 230 MPa. (20)
   v. Pinion diameter is limited to 125 mm.

   Determine the axial thrust on the shaft and check the gears for dynamic and wear loads.

MODULE V

9. A pair of straight bevel gears transmits 15 kW at 1250 pm of 120 mm diameter pinion. The speed reduction is 3.5. Use 14.5° involute tooth system. The angle between the shaft axes is 90°. The pinion is made of case hardened alloy steel with allowable static stress of 343.34 MPa and gear is cast steel of 0.20% C heat treated with allowable static stress of 191.295 MPa. Determine module, face width, number of teeth on pinion and gear. Suggest suitable surface hardness for the gear pair. Take the service factor as 1.5 and assume the teeth are generated. (20)

OR

10. Design a worm gear drive to transmit 2 kW of power at 1000 pm. The speed ratio is 20 and center distance is 200 mm. Assume the number of teeth on worm wheel to be 40 and number of starts on worm to be 2. Assume hardened steel worm and phosphor bronze wheel for which = 55 N/mm^2. Check the gear from stand point of strength and wear if load stress factor, K = 0.69 MPa. If the amount of heat generated is 1.7 KW, check whether artificial cooling is necessary or not for a temperature rise of 40 °C. (20)

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