

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

**SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)**

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

**FIRST SEMESTER M.TECH DEGREE EXAMINATION (R), DECEMBER 2023****MACHINE DESIGN****(2021 Scheme)****Course Code: 21MD104-B****Course Name: Design of Power Transmission Elements****Max. Marks: 60****Duration: 3 Hours**

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

**PART A****(Answer all questions. Each question carries 3 marks)**

1. List the different types of materials used for flat belts.
2. What is the reason for selecting even number of pitches or links for roller chain?
3. Describe virtual number of teeth in helical gear.
4. Discuss the design considerations for a multi-speed gear box in machine tool applications.
5. Why clutches are usually designed on the basis of uniform wear?
6. Explain working principle of electromagnetic clutch.
7. Differentiate between self-energizing block brake and self-locking block brake.
8. What is the advantage of pivoted shoe brake over fixed shoe brake?

**PART B****(Answer one full question from each module, each question carries 6 marks)****MODULE I**

9. A flat belt drive is required to transmit 20kW power at 1440rpm. The driver and driven shaft are 3m apart. The dimensions of the pulley mounted on the driver and driven shafts are 300mm and 450mm respectively. The weight density of belt is 9.7kN/m<sup>2</sup>, allowable design stress  $\sigma_d = 2 \text{ N/mm}^2$  and coefficient of friction =0.3. Determine a) width of the belt if the thickness is 6mm, b) length of the belt, c) initial tension in belt, d) centrifugal tension in the belt. (6)

**OR**

10. Explain types of belts used for power transmission. (6)

**MODULE II**

11. a) Design a chain drive to connect a 12 kW, 1400 rpm electric motor to (4)

a centrifugal pump running at 700 rpm. The service conditions involve moderate shocks.

- b) How will you designate roller chain? (2)

**OR**

12. a) A roller chain is to transmit 60kW from a 17-tooth sprocket running at 400rpm to a 34-tooth sprocket. The load characteristics are moderate shock with abnormal service conditions and works 10 hours per day. Design a roller chain assuming center of distance of 30 pitch. (6)

**MODULE III**

13. Write a note on gear tooth failures. (6)

**OR**

14. A pair of straight teeth spur gear is to transmit 20kW when pinion rotates at 300rpm. The velocity ratio is 3:1. The allowable static stresses for pinion and gear materials are 120MPa and 100MPa respectively. The pinion has 15 teeth and its face width is 10 times its module. The tooth form factor is  $\gamma = 0.154 - 0.912/z$ , velocity factor  $C_v = 3/(3+v)$ , where v is in m/s. Determine a) module b) face width c) PCD of gears. (6)

**MODULE IV**

15. a) In what way the kinematic arrangement is linked with ray diagram? Explain with example. (3)  
b) With neat sketch explain sliding mesh gear box (3)

**OR**

16. Design a gear box to give 18 speeds for a spindle of a milling machine. The drive is from an electric motor of 5 HP. at 1000 rpm. Maximum and minimum speeds of the spindle are to be around 650 rpm and 35 rpm respectively (6)

**MODULE V**

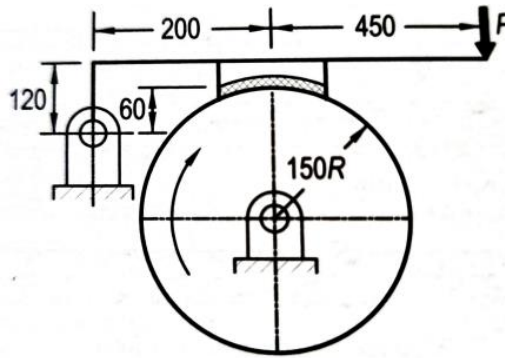
17. A single plate friction clutch of both sides effective has 0.3m outer diameter and 0.16m inner diameter. The coefficient of friction is 0.2 and it runs at 1000rpm. Find the power transmitted for uniform wear and uniform pressure distribution cases if the allowable maximum pressure is 0.08MPa. (6)

**OR**

18. Explain the following theories (6)  
a) uniform wear theory b) uniform pressure theory

## MODULE VI

19. A single-block brake with a torque capacity of 15 N-m is shown in Figure (6) below. The coefficient of friction is 0.3 and the maximum pressure on the brake lining is 1 N/mm<sup>2</sup>. The width of the block is equal to its length. Calculate:
- The actuating force
  - The dimensions of the block
  - The resultant hinge-pin reaction
  - The rate of heat generated, if the brake drum rotates at 50 rpm.



OR

20. Explain internal expanding shoe brake with neat sketch. What are the advantages of internal expanding shoe brake? (6)

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