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

SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

SEVENTH SEMESTER B.TECH DEGREE EXAMINATION (S), FEBRUARY 2024
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 are the different types of shafts used? Provide a brief explanation of each type? (3)

   b) 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 center of 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 coefficient of friction between the belt and the 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. (17)

OR

2. a) What factors should be considered in the selection of a belt drive system? (3)

   b) A horizontal drive is required to drive a compressor by means of an electric motor. Select a suitable flat belt drive from the following details:
   Power = 6 kW, slip = 2.5%, speed of motor pulley = 1400 rpm, service factor = 1.2, working stress = 2 MPa, joint efficiency = 90%, speed of compressor = 500 rpm. (17)

MODULE II

3. a) Explain the classification of clutches used in mechanical systems, and provide examples of each type along with their respective applications. (4)

   b) Give a complete design analysis for a single plate clutch, with both sides effective to transmit 22 kW at 2800 rpm, allowing an overload of 25%. The pressure intensity is not to exceed 0.08 MPa and (16)

surface speed at mean radius is not to exceed 2000 pm. Take μ = 0.35 and the ratio of D_o/D_i = 1.5. The axial thrust is provided by 6 springs of 24 mm coil diameter. Take shear stress = 420 MPa and G = 84 GPa for the spring material.

OR

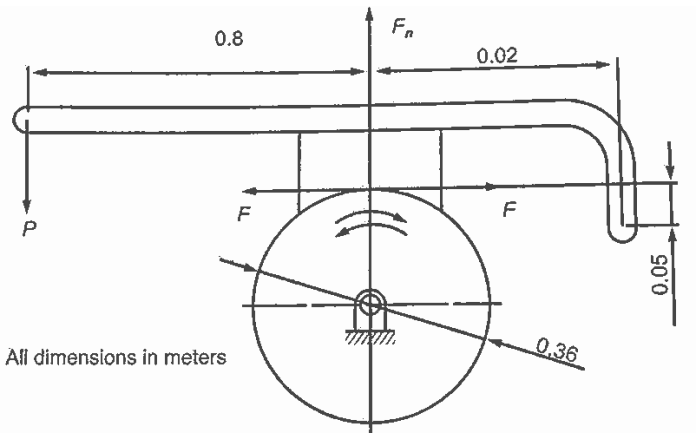
4. a) Write short notes on Mechanical Brakes. (4)

b) Figure shown below is a cast iron brake shoe. The coefficient of friction is 0.30. The braking torsional moment is to be 346 N. Determine:

a. The force P, for anticlockwise rotation.

b. The force P, for clockwise rotation.

c. Where must be the pivot be placed to make the brake self-energizing with the counter clockwise direction. (16)



MODULE III

5. a) What are the classifications of lubricants? (3)

b) Design a journal bearing for a centrifugal pump from the following data:
Load on the journal = 10 kN
Speed of the journal = 900 rpm
Ambient temperature = 15 °C (17)

OR

6. a) What are the purposes of lubricants? (3)

b) A lightly loaded journal bearing has the following specifications:
Bearing diameter = 80 mm
Bearing length = 60 mm
Diametral Clearance = 0.12 mm
Journal Speed = 24000 rpm
Radial load = 900 N
Absolute viscosity = 4 cP
Determine,
   a. Frictional force
   b. Torque (17)

c. Coefficient of friction
d. Power loss

MODULE IV

7. 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. (20)

OR

8. A pair of helical gears are to transmit 15 kW. The teeth are 20° stub in diametral plane and have a helix angle of 45°. The pinion runs at 10000 pm and has 80 mm pitch diameter. The gear has a pitch diameter of 320 mm. If gears are made of cast steel having allowable static strength of 100 MPa; determine module and face width from static strength considerations and check the gears for wear, given σ_{es} = 618 MPa. (20)

MODULE V

9. A pair of straight tooth bevel gears at right angles is to transmit 5 kW at 1200 rpm of the pinion. The diameter of the pinion is 80 mm and the velocity ratio is 3.5. The tooth form is 14 ½°. Both the pinion and gear are cast iron with allowable stress of 55 MN/m^2. Determine the module, face width from the standpoint of strength and also check the design from standpoint of dynamic load and wear. (20)

OR

10. Design a suitable worm gearing with the following details:
Power = 3.75 kW, speed ratio = 27, pressure angle = 14.5°, center distance = 180 mm, worm speed = 1200 pm. The material for the worm is hardened steel with design stress as 45 MPa and that for worm wheel is phosphor bronze with a design stress of 52 MPa. (20)

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