Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S7 (S,FE) (FT/WP/PT) Examinations May 2026 (2019 Scheme)

Course Code: MET401

Course Name: DESIGN OF MACHINE ELEMENTS

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

Use of Approved Design Data handbook permitted

PART A

Answer all questions, each carries 3 marks. Marks

1	What is critical speed of a shaft? Give the equation for critical speed.	(3)
2	Define centrifugal tension in belt drives. State its significance in design.	(3)
3	List the properties which are essential for brake lining materials.	(3)
4	State the advantages and limitations of cone clutch.	(3)
5	Define the terms: (i) eccentricity, (ii) minimum film thickness, and (iii) Diametral clearance ratio.	(3)
6	Define the terms bearing life and rating life of a rolling contact bearing.	(3)
7	List the different types of gear tooth failures.	(3)
8	Define the terms: i) Helix angle ii) Normal Pitch iii) Formative number of teeth applied to helical gears.	(3)
9	With the help of a neat sketch, list the forces acting in a bevel gear.	(3)
10	List the characteristics of worm gears.	(3)

PART B

Answer any one full question from each module, each carries 14 marks.

Module I

11	A shaft is supported by two bearings placed 1000 mm 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 180^0 and coefficient of friction is 0.24. Determine the suitable diameter for a solid shaft allowing working 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.	(14)

OR

12 Design a flat belt to drive a compressor from an electric motor of 12 kW having a speed ratio of 3. The speed of motor shaft is 900 rpm. Assume a service factor of 1.5. (14)

Module II

13 A plate clutch having a single driving plate with contact surfaces on each side is required to transmit 110 kW at 1250 rpm. The outer diameter of the contact surfaces is to be 300 mm. the coefficient of friction is 0.4. (14)

a) Assuming a uniform pressure of 0.17 N/mm^2, determine the inner diameter of the friction surfaces.

b) Assuming the same dimensions and the same total axial thrust, determine the maximum torque that can be transmitted and the maximum intensity of pressure when uniform wear conditions have been reached.

OR

14 A differential band brake as shown in figure 1 has an angle of contact of 225^0. The band has a compressed woven lining and bears against a cast iron drum of 350 mm diameter. The brake is to sustain a torque of 350 N-m and coefficient of friction between band and the drum is 0.3. find (14)

a) The necessary force F, for clockwise and anti-clockwise rotation of the drum.

b) The value of OA for the brake to be self-locking, when the drum rotates clockwise.

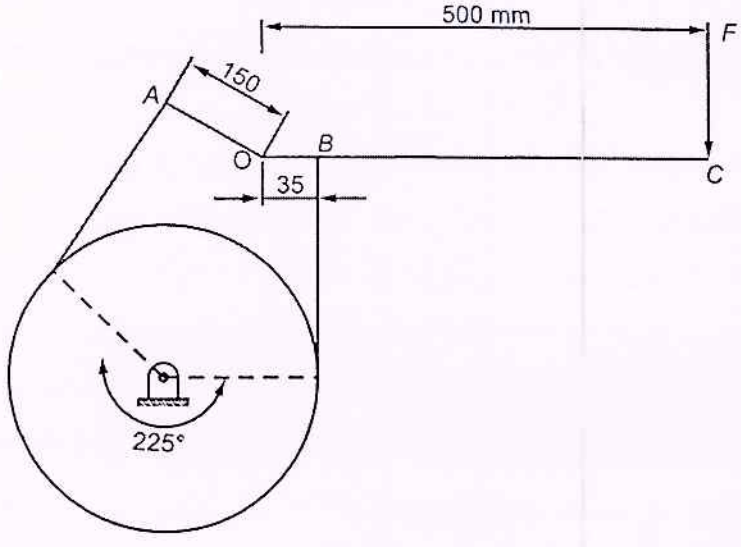

Figure 1

Module III

15 Select a suitable single row deep groove ball bearing for a radial load of 2500 N and axial load 1000 N, operating at a speed of 2000 rpm. The bearing works for 8 hours per day, 300 days per year for 5 years. Assume that the outer race rotating and the bearing is subjected to moderate shocks. (14)

OR

16 The following data is given for 360^0 hydrodynamic bearing. (14)

Radial load = 3.2 kN

Journal diameter = 50 mm

Journal speed = 1490 rpm

Bearing length = 50 mm

Radial clearance = 0.05 mm

Viscosity of lubricant = 25 centipoise

Assume total heat generated in bearing is carried by the total oil flow in the bearing. Calculate (i) Bearing pressure (ii) Coefficient of friction (iii) Power lost in friction (iv) Oil film thickness (v) Flow rate in L/min.

Module IV

17 A pair of straight teeth spur gears, having 20^0 involute full depth teeth is to transmit 16 kW at 300 rpm of the pinion. The speed ratio is 2:1. The material for gear and pinion are cast iron and steel respectively. Design the pair and check for safety. (14)

OR

18 Design a helical gear pair having helix angle 25^0 is to transmit a power of 15 KW from a shaft running at 1000 rpm to another shaft to be run at 360 rpm. Assume involute profile with a pressure angle of 20^0. The material of the pinion is forged steel SAE 1030 whose static stress is 172.375 MPa and the material for gear is cast steel 0.2%C untreated with a static stress of 137.42 MPa. The gears operate under a condition of medium shock for a period of 10 hours per day. Check for dynamic load, if the load factor is 580N/mm and also for the wear load. (14)

Module V

19 A pair of straight tooth bevel gears at right angles is to transmit 5 KW at 1500 rpm of the pinion at a speed ratio of 3. Diameter of the pinion is 75 mm. the tooth form is 14 ½ ^{0}involute. Pinion is made of steel having static stress of 160 MPa and gear (14)

is made of Cast iron having static stress value of 80 MPa. Design the gear pair and check the design for dynamic load wear.

OR

20 Design a suitable worm gearing with the following details: (14)

Power: 75 KW, speed ratio: 27, Pressure angle: 14.5^0, centre distance: 180 mm, worm speed: 1200 rpm. 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.

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