Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Seventh Semester B.Tech Degree Examination December 2022 (2019 scheme)

Course Code: MET401

Course Name: DESIGN OF MACHINE ELEMENTS

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

PART A

Answer all questions, each carries 3 marks.

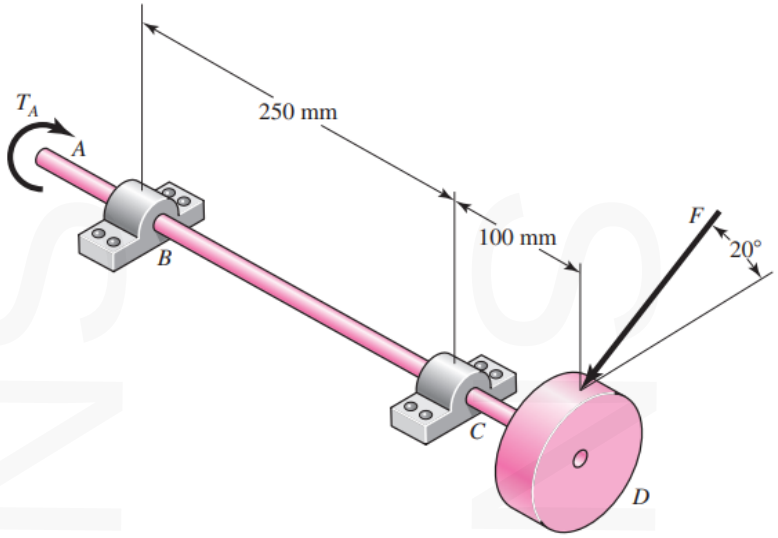
		Marks
1	What is the advantage of having I section in connecting rods?	(3)
2	Explain strength-based design and rigidity-based design.	(3)
3	Explain uniform wear theory and uniform pressure theory in friction clutches.	(3)
4	What do you mean by self-locking and self-energizing in brakes?	(3)
5	Distinguish between hydrostatic and hydrodynamic bearings.	(3)
6	Define (i) bearing characteristic number (ii) Sommerfeld number.	(3)
7	What is Lewi's form factor? How does it vary with number of teeth on gear?	(3)
8	Define virtual number of teeth in helical gears.	(3)
9	How will you estimate the wear strength of bevel gear?	(3)
10	List the demerits of worm gear drive over other gear drives.	(3)

PART B

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

Module I

11	The rotating solid steel shaft is simply supported by bearings at points B and C and is driven by a gear (not shown) which meshes with the spur gear at D, which has a 150-mm pitch diameter. The force F from the drive gear acts at a pressure angle of 20°. The shaft transmits a torque to point A of $T_A = 340$ N · m. The shaft is machined from steel with yield tensile strength, $\sigma_y = 420$ MPa and ultimate tensile strength,$\sigma_{ut} = 560$ MPa. Using a factor of safety of 2.5, determine the minimum allowable diameter of the 250-mm section of the shaft based on maximum normal stress.	(14)

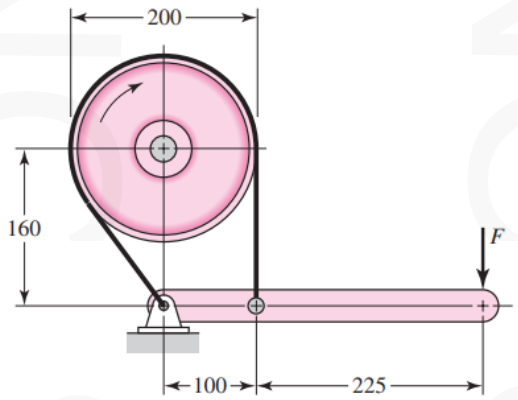


OR

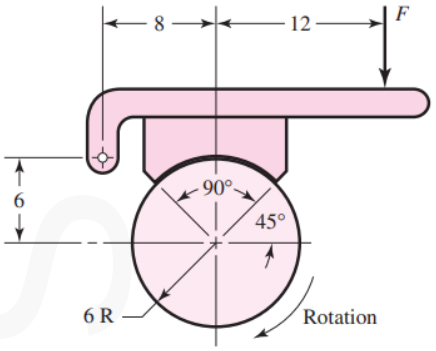
12 Design a belt drive to transmit 30 hp at 740 rpm to an aluminium rolling machine, the speed ratio being 3. The distance between the pulleys is 3 m. Diameter of the rolling machine pulley is 1.2 m. (14)

Module II

13 a) The brake shown in the figure (with dimensions in mm) has a coefficient of friction of 0.30 with an angle of contact of 270˚ and is to operate using a maximum force F of 400 N. If the band width is 50 mm, find the band tensions and the braking torque. (8)



b) The block-type hand brake shown in the figure (with dimensions in cm) has a face width of 12.5 mm and a mean coefficient of friction of 0.25. For an estimated actuating force of 900 N, find the maximum pressure on the shoe and find the braking torque (6)



OR

14 a) A hydraulically operated multi disk plate clutch has an effective disk outer diameter of 6.5 cm and an inner diameter of 4 cm. The coefficient of friction is 0.24, and the limiting pressure is 0.3N/mm^2. There are six planes of sliding present. Using the uniform wear model, estimate the axial force F and the torque T. (8)

b) Derive an expression for the axial force and torque in the case of a cone clutch assuming uniform wear theory. (6)

Module III

15 Select a suitable deep groove ball bearing for supporting a radial load 20 kN and axial load of 6 kN for a life of 4000 hours at 1000 rpm. Select from series 63. Calculate expected life of the selected bearing. (14)

OR

16 Design a suitable journal bearing for a centrifugal pump using the following data: Load on the bearing = 8 kN, diameter of the journal = 80 mm, speed = 1440 rpm, at the working temperature 75˚C. Calculate cooling requirements, if any. (14)

Module IV

17 Design a pair of spur gear to transmit 10 kW at a pinion speed of 2000 rpm. The driven gear is to run at 500 rpm. Selecting suitable materials, decide upon the dimensions of the gear pair. (14)

OR

18 Design a pair of helical gears to transmit 10 kW at 1000 rpm of the pinion. A speed reduction ratio of 5 is required. Give the details in a table and show the nomenclature in a neat sketch. (14)

Module V

19 A pair of bevel gears is required to transmit 30 kW at 500 rpm. The output shaft is running at 200 rpm and is at right angles to the input shaft. The gear is of cast iron and the pinion of cast steel. Design the gears. (14)

OR

20 Determine the dimensions of a pair of worm and worm wheel for transmitting 2 kW at a worm speed of 1200 rpm. The desired ratio is about 12. Choosing proper materials decide all the dimensions. (14)

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Seventh Semester B.Tech Degree (S, FE) Examination May 2023 (2019 Scheme)

Course Code: MET401

Course Name: DESIGN OF MACHINE ELEMENTS

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

PART A

Answer all questions, each carries 3 marks. Marks

1	What types of stresses are induced in shafts?	(3)
2	What is the manufacturing method for connecting rod?	(3)
3	Why are clutches usually designed on the basis of uniform wear?	(3)
4	What is a differential band brake?	(3)
5	State desirable properties of a good lubricant.	(3)
6	Enumerate the advantages of needle roller bearings.	(3)
7	What are the advantages of 20 degree full depth involute teeth gears?	(3)
8	Compare the contact between mating teeth of parallel and crossed helical gears.	(3)
9	What is the relationship between actual and virtual number of teeth and the pitch angle in bevel gears?	(3)
10	Why is the efficiency of worm gear drive low?	(3)

PART B

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

Module I

11	A shaft of a motor is supported at two points which are 900 mm apart. The motor develops 20 kW at 1500 rpm. The armature of the motor can be considered as a uniformly distributed load of 15 N/mm, centrally spread over a length of 600 mm, selecting a suitable material and choosing appropriate value for the factor of safety, determining the diameter of the motor shaft.	(14)

OR

12	Select a suitable flat belt for a horizontal drive for a compressor. An electric motor of 6.5 kW having a speed of 1500 rpm is used to drive the compressor. The speed of the compressor pulley is 500 rpm. Assume a service factor of 1.2, slip = 2.5 %, and working stress of 2.3 MPa.	(14)

Module II

13 A single plate clutch having one pair of contacting surfaces to transmit 15 kW at 1500 rpm. The coefficient of friction between contact face is 0.35 and the permissible intensity of pressure should not exceed 0.6 N/mm^2. The outer diameter of the clutch is 300 mm. Determine the clutch dimensions by assuming uniform wear theory. (14)

OR

14 A simple band brake is to be designed to stop the rotation of a shaft transmitting a power of 50 kW at a rated speed of 600 rpm. The diameter of the drum is 600 mm, angle of contact of the band on drum is 225^0 and the total length of the lever is 1000 mm. Distance between the fulcrum and the other end of the band is 300 mm. The drum rotates in the clockwise direction and free end of the lever at the left side of the drum. Selecting suitable materials determine: (i) band dimensions, (ii) brake lever dimensions, and (iii) diameter of fulcrum pin. (14)

Module III

15 A lightly loaded 0.1 m long journal bearing is acted on by 0.6 kN radial load. The 0.07 m diameter journal is rotating at 1500 rpm. The viscosity of the oil is 3.5 cP and radial clearance of 5×10^{-5} m. Determine the frictional power loss using Petroff's equation. (14)

OR

16 Select suitable deep groove ball bearing for a shaft diameter of 50 mm. The shaft operates at 3000 rpm and is acted upon by steady and continuous 5000 N radial load and 2000 N thrust load. The life expectancy of the bearing is 20000 hours. (14)

Module IV

17 Design a pair of spur gear to transmit 20 kW power with velocity ratio of 4:1. The pinion is rotating at 1200 rpm. The centre distance between parallel shaft is 150 mm.The allowable static stress for pinion and gear materials are 206.3 MPa and 137.2 MPa respectively. (14)

OR

18 Design a pair of equal diameter helical gears to transmit 35 kW at 1000 rpm. The parallel shafts are 0.5 m apart. Assume the helix angle is 30^0, pressure angle is 20^0 stub. The gear is made of steel. (14)

Module V

19 a) Under what circumstances the bevel gears are used? Give a detailed classification of bevel gears. (4)

b) With a neat sketch explain the terminology of bevel gears. (10)

OR

20 Five kW of power at 1500 rpm is supplied to the worm shaft. The normal pressure angle is 20^0 degrees and coefficient of friction is 0.1. Determine the components of gear tooth force acting on the worm and worm wheel. The worm and worm gear is designated as 3/60/10/8. (14)

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