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Pages: 3

Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S7 (R, S) / S7 (PT) (R,S) Examination November 2024 (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	Explain rigidity-based shaft design with one good example.	(3)
2	What are the desirable properties of a belt material from design point of view?	(3)
3	Distinguish between simple band brake and differential band brakes?	(3)
4	Justify why clutches are usually designed on the basis of uniform wear theory.	(3)
5	Write down the limitations of Petroff's equation and how it can be compensated.	(3)
6	Define static and dynamic load bearing capacities of rolling contact bearing.	(3)
7	What stresses are induced in gear tooth?	(3)
8	Explain two basic modes of gear tooth failure.	(3)
9	Write down the expressions for three components of resultant tooth force in bevel gears.	(3)
10	List the advantages and disadvantages of worm gear drives.	(3)

PART B

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

Module I

11	A mild steel shaft rotating at 900 rpm is supported between two bearings 800 mm apart. It carries two pulleys A and B at distance of 300 mm and 600 mm respectively from the left bearing. 12 kW of power is fed into the pulley A with a diameter of 400 mm and taken out at the pulley B with a diameter of 300 mm by vertical belt drives having the same ratio of driving tensions, which was observed to be 2.5. Design the diameter of the shaft assuming the working stresses in tension and shear as $\sigma_d = 75$ N/mm^2 and $\tau_d = 45$ N/mm^2.	(14)

OR

12 A flat belt drive is to transmit 15 hp at 1200 rpm from a driving shaft to driven shaft with a speed ratio of 4:1. The centre to centre distance between the pulleys is approximately 2.5 m. Design the belt drive if the diameter of the driving shaft pulley is 150 mm. (14)

Module II

13 a) A differential band brake is shown in Figure-1. The width and the thickness of the steel band are 100 mm and 3 mm respectively and the maximum tensile stress in the band is 50 N/mm^2. The coefficient of friction between the friction lining and the brake drum is 0.25. Calculate (10)

(i) The tension in the band.

(ii) The actuating force.

(iii) The torque capacity of the brake.

Also find out whether the brake is self-locking?

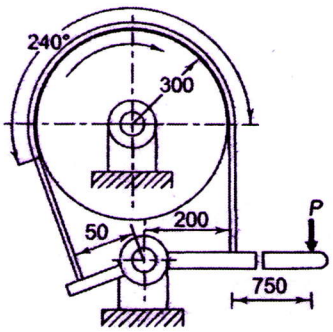

Figure-1

b) Explain why an equivalent coefficient of friction is used while designing long shoe drum brake? (4)

OR

14 A centrifugal clutch, transmitting 20 kW at 750 rpm consists of four shoes. The clutch is to be engaged at 500 rpm. The inner radius of the drum is 165 mm. The radius of the centre of gravity of the shoes is 140 mm, when the clutch is engaged. The coefficient of friction is 0.3, while the permissible pressure on friction lining is 0.1 N/mm^2. Calculate: (14)

(i) The mass of each shoe; and

(ii) The dimensions of friction lining.

Module III

15 Design a journal bearing for supporting a centrifugal pump shaft of diameter 90 mm, running at 900 rpm. The radial load acting on the bearing is 20 kN. (14)

OR

16 A single row deep-groove ball bearing is subjected to a radial force of 5 kN and a thrust force of 3 kN. The shaft rotates at 1200 rpm. The expected life L_{10h} of the bearing is 18000 hours. The minimum acceptable diameter of the shaft is 75 mm. Select a suitable ball bearing for this application. (14)

Module IV

17 In a spur gear drive the pinion is made of cast steel rotating at 1400 rpm is driving a cast iron gear at 560 rpm. The teeth are to have 20^0 involute system and the maximum power to be transmitted is 30 kW. Design the gear drive if the allowable static stresses for pinion and gear wheels are 120 MPa and 60 MPa. The steel pinion has a surface hardness of 250 BHN. Assume modulus of elasticity of pinion (E_p) as 150 GPa and for gear wheel (E_g) as 207 GPa. (14)

OR

18 Two helical gears are used in a speed reducer that is to driven by an internal combustion engine. The rated power of the speed reducer is 75 kW at a pinion rotational speed of 1200 rpm. The speed reduction ratio is 3:1. Assume medium shock conditions and 24 hours operation. Design the gear drive by selecting alloy steel for both pinion and gear wheel if the teeth are 20^0 full depth involute profile in the normal plane. (14)

Module V

19 A pair of straight bevel gears are to transmit 15 kW at 1500 rpm input speed. The number of teeth on the pinion is 20 and the speed ratio is 5. Design the gears assuming 14.5^0 full depth involute tooth profile. (14)

OR

20 Design a worm gear drive for a speed reduction ratio of 25. The pinion rotates at 600 rpm and transmits 35 kW. (14)

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