Code: 20ME3603

III B.Tech - II Semester – Regular / Supplementary Examinations APRIL 2024

DESIGN OF TRANSMISSION ELEMENTS
(MECHANICAL ENGINEERING)

Duration: 3 hours   Max. Marks: 70

Note: 1. This paper contains questions from 5 units of Syllabus. Each unit carries 14 marks and have an internal choice of Questions.
2. All parts of Question must be answered in one place.

BL – Blooms Level   CO – Course Outcome

* Use of Approved Design Data book is permitted *

			BL	CO	Max. Marks
UNIT-I					
1	a)	What do you understand by torsional rigidity?	L1	CO1	4 M
	b)	A propeller shaft is required to transmit 45 kW power at 500 rpm. It is a hollow shaft having inside diameter 0.6 times of outside diameter. It is made of plain carbon steel and the permissible shear stress is 84 kN/mm^2. Calculate the inside and outside diameters of the shaft.	L3	CO4	10 M
OR					
2	It is required to design a bushed pin type flexible coupling to connect the output shaft of an electric motor to the shaft of a centrifugal pump. The motor delivers 20 kW power at 720 rpm. The starting torque of the motor can be assumed to be 150% of the rated torque. Design the coupling and specify the dimensions of its components.		L4	CO4	14 M
UNIT-II					
3	a)	What are the advantages of V-belts over flat-belts ?	L1	CO1	4 M

	b)	An open-belt drive is required transmit 10 kW of power from a motor running at 600 rpm. Diameter of the driving pulley is 250 mm. The speed of the driven pulley is 220 rpm. The belt is 12 mm thick and has a mass density of 0.001 g/mm^3. Safe stress in the belt is not to exceed 2.5 N/mm^2. The two shafts are 1.25 m apart. The coefficient of friction is 0.25. Determine the width of the belt.	L3	CO2	10 M

OR

4	a)	Explain the applications of chine drives.	L2	CO1	2 M
	b)	Design a roller chain drive to transmit power from a 15kW motor to a reciprocating pump. The speed of motor is 570 rpm and pump is running at 200 rpm. Determine the number of teeth on each sprocket, pitch and length of chain. Use the data given in the table.	L4	CO2	12 M

Power Rating of Simple Roller Chain

Pinion Speed (rpm)	Power kW								
	06B	08A	08B	10A	10B	12A	12B	16A	16B
500	1.09	2.24	2.72	4.34	5.07	7.69	8.53	16.99	20.57
700	1.48	2.95	3.66	5.91	6.71	10.73	11.63	23.26	27.73

UNIT-III

5	a)	A ball bearing is subjected to a radial force of 2500 N and an axial force of 1000 N. The dynamic load carrying capacity of the bearing is 7350 N. The values of X and Y factors are 0.56 and 1.6 respectively. The shaft is rotating at 720 rpm. Calculate the life of the bearing.	L3	CO3	7 M
	b)	A system involves four identical ball bearings, each subjected to a radial load of 2500 N. The reliability of the system, i.e., one out of four bearings failing during the lifetime of five	L3	CO3	7 M

		million revolutions, is 82%. Determine the dynamic load carrying capacity of the bearing, so as to select it from the manufacturer's catalogue based on 90% reliability.			
		OR			
6	a)	Write the advantages and disadvantages of rolling-contact bearings over sliding contact bearings.	L2	CO1	4 M
	b)	Following data is given for a 360° hydrodynamic bearing: journal diameter = 100 mm, bearing length = 100 mm, radial load = 50kN, journal speed = 1440 rpm, radial clearance = 0.12 mm, viscosity of lubricant = 16 cP Calculate: (i) minimum film thickness; (ii) coefficient of friction; and (iii) power lost in friction.	L3	CO3	10 M
		UNIT-IV			
7	a)	Describe with the help of neat sketches the working principle of anyone friction clutch	L2	CO1	4 M
	b)	A single plate clutch (both sides effective) is required to transmit 48kW at 1900 rpm. The outer diameter of the plate is limited to 350 mm and intensity of pressure between the plates is not to exceed 75 kN/m^2. Assuming uniform wear and a coefficient of friction 0.28, find the inner diameter of the plate.	L3	CO3	10 M
		OR			
8	a)	Describe with the help of neat sketches the working principle of anyone Brake.	L2	CO1	4 M

	b)	A band and block brake has 10 blocks and each block subtends an angle of 15º at the centre of the wheel. The two ends of the band are fixed to pins on the opposite sides of the brake fulcrum at distances of 40 mm and 200 mm from it. Determine the maximum force required to be applied on the lever at a distance of 300 mm from the fulcrum to absorb 250 kW of power at 280 rpm. The effective diameter of the drum is 840 mm. Take $\mu = 0.35$.	L3	CO3	10 M

UNIT-V

9	a)	What are the advantages of Helical gears?	L2	CO1	4 M
	b)	A pair of parallel helical gears consists of an 18 teeth pinion meshing with a 45 teeth gear. 7.5 kW power at 2000 rpm is supplied to the pinion through its shaft. The normal module is 6 mm, while the normal pressure angle is 20^0. The helix angle is 23^0. Determine the tangential, radial and axial components of the resultant tooth force between the meshing teeth.	L3	CO4	10 M

OR

10	The pitch circle diameters of the pinion and gear are 100 mm and 300 mm respectively. The pinion is made of plain carbon steel 40C8 ($S_{ut} = 600$ N/mm^2) while the gear is made of grey cast iron FG 300 ($S_{ut} = 300$ N/mm^2). The pinion receives 5 kW power at 500 rpm through its shaft. The service factor and factor of safety can be taken as 1.5 each. The face width of the gear can be taken as ten times that of the module. Assume that the velocity factor accounts for the dynamic load. Calculate (i) module; and (ii) the number of teeth on the pinion and gear.	L4	CO4	14 M