Reg. No.															

Question Paper Code	14380

B.E. / B.Tech. - DEGREE EXAMINATIONS, APRIL / MAY 2026

Sixth Semester

Mechanical Engineering

20MEPC601 - DESIGN OF TRANSMISSION SYSTEMS

Regulations - 2020

(Use of PSG Design Data Book is permitted)

Duration: 3 Hours | Max. Marks: 100

PART – A (i) (MCQ)
(16 × 1 = 16 Marks)
Answer ALL Questions

		Marks	K – Level	CO
1.	For maximum efficiency and minimum wear in a wire rope pulley system, the wire rope should primarily make contact with which portion of the pulley groove? a) Only at the bottom of the groove b) Only at the sides of the groove c) At both the sides and bottom of the groove d) Uniformly throughout the entire groove surface	1	K2	CO1
2.	What is the usual groove angle of a pulley used in a V-belt drive? a) 20° – 25° b) 32° – 38° c) 25° – 32° d) 38° – 45°	1	K1	CO1
3.	In order to have smooth operation, the minimum number of teeth on the smaller sprocket, for moderate speeds, should be a) 15 b) 21 c) 17 d) 25	1	K1	CO1
4.	The Lewis equation is used in spur gear design mainly to determine the gear tooth strength against which type of stress? a) tensile stress in bending b) shear stress c) compressive stress in bending d) fatigue stress	1	K2	CO2
5.	If T is the actual number of teeth on a helical gear and φ is the helix angle for the teeth, the formativenumber of teeth is written as a) $T \sec^3 \varphi$ b) $T/\sec^3\varphi$ c) $T \sec^2 \varphi$ d) T cosec φ	1	K1	CO2
6.	A machine designer selects a helical gear instead of a spur gear mainly to obtain: a) Lower manufacturing cost b) Smooth and quiet power transmission c) Higher backlash d) Reduced gear tooth contact	1	K3	CO2
7.	Which gear arrangement is preferred in automobile differentials for changing the direction of power transmission? a) Helical gear b) Worm gear c) Bevel gear d) Spur gear	1	K3	CO3
8.	The self-locking property in a worm gear drive is mainly due to: a) High efficiency b) Large pressure angle c) High friction between worm and worm wheel d) Absence of sliding motion	1	K2	CO3
9.	A worm gear drive is preferred over other gear drives when the design requirement mainly includes: a) Small speed reduction ratio b) Large centre distance c) High speed reduction in compact space d) Zero heat generation	1	K3	CO3

10. Which type of gearbox is commonly used in automobiles for smooth gear shifting? *1* *K1* *CO4*

a) Worm gearbox b) Sliding mesh gearbox

c) Synchromesh gearbox d)Epicyclic train only

11. In a synchromesh gearbox, synchronizer rings are mainly used to: *1* *K2* *CO4*

a) Increase shaft diameter b) Match the speed of gears before engagement

c) Reduce lubrication requirement d) Eliminate clutch operation

12. A machine requires high torque at low output speed from a compact transmission system. Which gearbox arrangement is most suitable? *1* *K3* *CO4*

a) Direct drive arrangement b) Reduction gearbox

c) Flat belt drive d) Rope drive

13. The axial force (We) required for engaging a cone clutch is given by *1* *K3* *CO5*

a) Wn sin α b) Wn (sin α + μ cos α)

c) Wn (sin α + 0.25 μ cos α) d) none of these

14. In case of a multiple disc clutch, if *n*1 are the number of discs on the driving shaft and *n*2 are thenumber of the discs on the driven shaft, then the number of pairs of contact surfaces will be *1* *K1* *CO5*

a) $n_1 + n_2$ b) $n_1 + n_2 - 1$

c) $n_1 + n_2 + 1$ d) none of these

15. A multi-plate clutch is preferred over a single-plate clutch in motorcycles mainly because it: *1* *K3* *CO6*

a) Requires no lubrication b) Transmits more torque in compact space

c) Eliminates friction completely d) Operates without pressure plates

16. Brake fading in vehicles occurs mainly due to: *1* *K2* *CO6*

a) Excessive cooling b) Reduction in friction caused by overheating

c) Increased brake lining thickness d) Low wheel speed

PART – A (ii) (Short Answer Questions)
(6 × 3 = 18 Marks)

Answer ALL Questions

17. State any two reasons why V-belt drives are preferred over flat belt drives. *3* *K3* *CO1*

18. Illustrate the condition required for correct gearing. *3* *K3* *CO2*

19. Differentiate the features of single-enveloping and double-enveloping worm drives. *3* *K3* *CO3*

20. Investigate any three basic rules to be considered while designing a gear box. *3* *K4* *CO4*

21. Explain why clutches are generally designed based on uniform wear theory. *3* *K3* *CO5*

22. Examine the working principle of a self-energizing brake and its advantages. *3* *K4* *CO6*

PART - B (Descriptive Answer Questions)
(6 × 11 = 66 Marks)

Answer ALL Questions

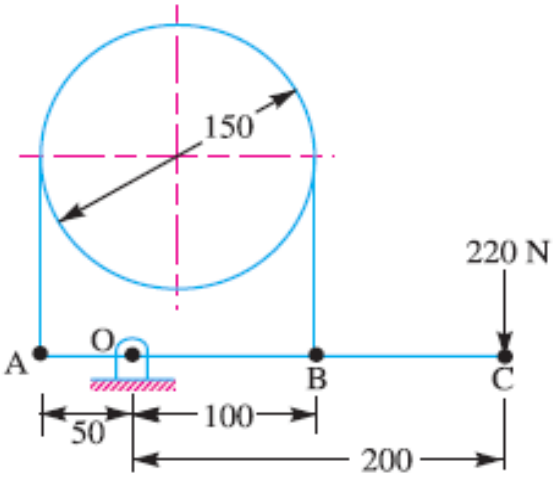
23. a) A V-belt drive transmits power of 75 kW at 1440 rpm. The speed of the driven wheel is 400 rpm. The diameter of the driving wheel is 300 mm, and the centre distance is 2500 mm. The service is 16 hours per day. Calculate the Centre distance of the V-belt for the given specifications. *11* *K3* *CO1*

OR

	b)	A workshop crane is lifting a load of 25 kN through a wire rope and a hook. The weight of the hook etc. is 15 kN. The rope drum diameter may be taken as 30 times the diameter of the rope. The load is to be lifted with an acceleration of 1 m/s^2. Calculate the diameter of the wire rope. Take a factor of safety of 6 and Young's modulus for the wire rope 80 kN/mm^2. The ultimate stress may be taken as 1800 MPa. The cross-sectional area of the wire rope may be taken as 0.38 times the square of the wire rope diameter.	*11*	*K3*	*CO1*
24.	a)	A gear drive is required to transmit a maximum power of 22.5 kW. The velocity, ratio is 1:2 and r.p.m. of the pinion is 200. The approximate centre distance between the shafts may be taken as 600 mm. The tooth has 20° stub involute profiles. The static stress for the gear material (which is cast iron) may be taken as 60 MPa and face width as 10 times the module. Find the module, face width and number of teeth on each gear. Check the design for dynamic and wear loads.	*11*	*K3*	*CO2*
		OR			
	b)	For intermittent duty of an elevator, two cylindrical gears made of alloy steel 40Ni2Cr1Mo28 transmit 12.5 kW at a pinion speed of 1200 rpm. The gear ratio is 3.5, the pressure angle is 20°, and the gears have involute full-depth teeth with a helix angle of 15°. The gears are expected to operate for 6 hours per day for 10 years. The minimum number of teeth on the pinion is 20, and the gears are of IS quality 8. Calculate the normal module of the gear pair for the given specifications.	*11*	*K3*	*CO2*
25.	a)	A pair of straight bevel gears is used for two shafts whose axes are at right angles. The power transmitted is 25 kW. The speed of the pinion is 300 rpm, and the speed of the gear is 120 rpm. The material for the pinion and gear is C45 steel, and the design life is 10000 hours. Calculate the transverse module of the bevel gear pair for the given specifications.	*11*	*K3*	*CO3*
		OR			
	b)	A steel worm running at 240 r.p.m. receives 1.5 kW from its shaft. The speed reduction is 10: 1**.** Design the drive so as to have an efficiency of 80%**.** Also determine the cooling area required**,** if the temperature rise is restricted to 45°C. Take overall heat transfer coefficient as 10 $W/m^2°C$**.**	*11*	*K3*	*CO3*
26.	a)	Design a 6 speed gearbox with a minimum speed of 160 rpm and a maximum speed of 500 rpm to determine the step ratio and construct the corresponding ray diagram and kinematic arrangement.	*11*	*K3*	*CO4*
		OR			
	b)	An all geared headstock of a lathe requires 12 spindle speeds ranging from 25 rpm to 600 rpm. The electric motor runs at 1440 rpm and transmits 2.25 kW power. Assuming a geometric progression for spindle speeds and a standard speed structure is already selected, calculate: 1. Step ratio, 2. Intermediate spindle speeds, 3. Transmission ratios for each stage and 4. Suitable number of teeth for one pair of gears.	*11*	*K3*	*CO4*
27.	a)	A multiple disc clutch, steel on bronze, is to transmit 4.5 kW at 750 r.p.m. The inner radius of the contact is 40 mm and outer radius of the contact is 70 mm. The clutch operates in oil with an expected coefficient of 0.1. The average allowable pressure is 0.35 N/mm^2. Find: 1). The total number of steel and bronze discs; 2). the actual axial force required; 3. the actual average pressure; and 4. the actual maximum pressure.	*11*	*K3*	*CO5*
		OR			

b) Describe, with the help of a neat sketch, a cone clutch and deduce an expression for the total frictional torque transmitted. How the shoes and springs are designed for such a clutch? | 11 | K3 | CO5

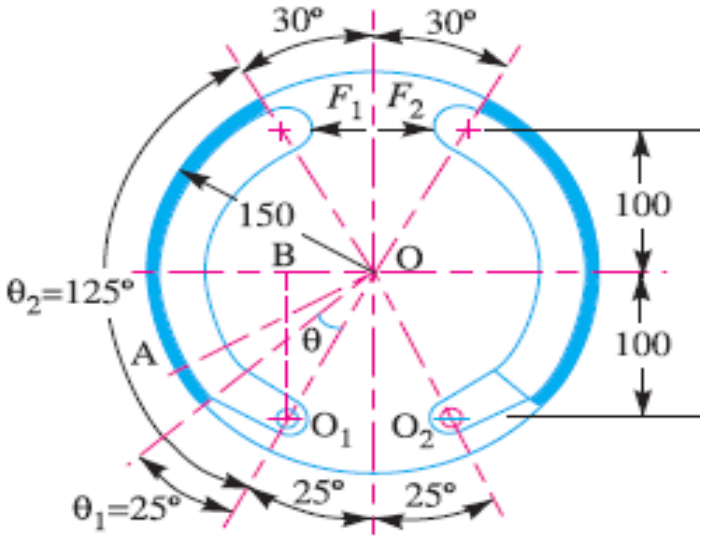
28. a) A differential band brake has a force of 220 N applied at the end of a lever as shown in Figure. The coefficient of friction between the band and the drum is 0.4. The angle of lap is 180°. Find: 1. The maximum and minimum force in the band, when a clockwise torque of 450 N-m is applied to the drum; and 2. The maximum torque that the brake may sustain for counter clockwise rotation of the drum. | 11 | K4 | CO6



All dimensions in mm.

OR

b) Figure shows the arrangement of two brake shoes which act on the internal surface of a cylindrical brake drum. The braking force F_1 and F_2 are applied as shown and each shoe pivots on its fulcrum O_1 and O_2. The width of the brake lining is 35 mm. The intensity of pressure at any point A is 0.4 sin θ N/mm^2, where θ is measured as shown from either pivot. The coefficient of friction is 0.4. Determine the braking torque and the magnitude of the forces F_1 and F_2 | 11 | K4 | CO6



All dimensions in mm.