Register Number:……..

KUMARAGURU college of technology
character is life

B.E/B.TECH DEGREE EXAMINATIONS: APRIL /MAY 2024

(Regulation 2018)

Fourth Semester

MECHATRONICS ENGINEERING

U18MCT4104: Theory of Machines

COURSE OUTCOMES

CO1: Apply concepts of mechanisms to achieve desired motion transformation.
CO2: Choose appropriate gear train and friction drives for a given application.
CO3: Calculate various forces acting on rigid bodies under static and dynamic conditions.
CO4: Solve balancing problems related to rotating and reciprocating masses.
CO5: Apply the fundamental concepts of vibrating system to predict the natural frequency and force transmitted.

Time: Three Hours **Maximum Marks: 100**

Answer all the Questions:-
PART A (10 x 2 = 20 Marks)
(Answer not more than 40 words)

1.	State Grashoff's law	CO1	[K_1]
2.	What are the different types of motion does the follower execute?	CO1	[K_2]
3.	Define module of gear.	CO2	[K_1]
4.	Mention the various types of brakes.	CO2	[K_1]
5.	State D' Alembert's principle.	CO3	[K_2]
6.	How does dynamic force analysis differ from static force analysis?	CO3	[K_2]
7.	Outline the requirements of balancing.	CO4	[K_1]
8.	Define tractive force.	CO4	[K_2]
9.	List out the types of vibration.	CO5	[K_1]
10.	What do you mean by vibration isolation?	CO5	[K_2]

Answer any FIVE Questions:-
PART B (5 x 16 = 80 Marks)
(Answer not more than 400 words)

11.	a)	What do you understand from the term inversion of a mechanism? Explain slider crank chain with sketch.	8	CO1	[K_3]
	b)	A four bar mechanism has the following dimensions : DA = 300 mm; CB = AB = 360 mm; DC = 600 mm. The link DC is fixed and the	8	CO1	[K_2]

angle ADC is 60°. The driving link DA rotates uniformly at a speed of 100 r.p.m. clockwise and the constant driving torque has the magnitude of 50 N-m. Determine the velocity of point B and angular velocity of the driven link CB.

12.	a)	A pinion having 30 teeth drives a gear having 80 teeth. The profile of the gears is involute with 20° pressure angle, 12 mm module and 10 mm addendum. Find the length of path of contact, arc of contact and the contact ratio.	10	CO2	[K_2]
	b)	Discuss the single plate clutch with neat sketch.	6	CO2	[K_3]
13.	a)	If the crank and the connecting rod are 300 mm and 1 m long respectively and the crank rotates at a constant speed of 200 r.p.m., Determine: 1. The crank angle at which the maximum velocity occurs, and 2. Maximum velocity of the piston.	8	CO3	[K_2]
	b)	In a slider crank mechanism, the length of the crank and connecting rod are 150 mm and 600 mm respectively. The crank position is 60° from inner dead centre. The crank shaft speed is 450 r.p.m. (clockwise). Using analytical method, determine: 1. Velocity and acceleration of the slider, and 2. Angular velocity and angular acceleration of the connecting rod	8	CO3	[K_3]
14.	a)	Four masses m_1, m_2, m_3 and m_4 are 200 kg, 300 kg, 240 kg and 260 kg respectively. The corresponding radii of rotation are 0.2 m, 0.15 m, 0.25 m and 0.3 m respectively and the angles between successive masses are 45°, 75° and 135°. Find the position and magnitude of the balance mass required, if its radius of rotation is 0.2 m	10	CO4	[K_2]
	b)	A single cylinder reciprocating engine has speed 240 r.p.m., stroke 300 mm, mass of reciprocating parts 50 kg, mass of revolving parts at 150 mm radius 37 kg. If two-third of the reciprocating parts and all the revolving parts are to be balanced, find : 1. The balance mass required at a radius of 400 mm, and 2. The residual unbalanced force when the crank has rotated 60° from TDC	6	CO4	[K_3]

15.	a)	The measurements on a mechanical vibrating system show that it has a mass of 8 kg and that the springs can be combined to give an equivalent spring of stiffness 5.4 N/mm. If the vibrating system have a dashpot attached which exerts a force of 40 N when the mass has a velocity of 1 m/s, find : 1. critical damping coefficient, 2. damping factor, 3. Logarithmic decrement, and 4. ratio of two consecutive amplitudes	8	CO5	[K_2]
	b)	The mass of an electric motor is 120 kg and it runs at 1500 r.p.m. The armature mass is 35 kg and its C.G. lies 0.5 mm from the axis of rotation. The motor is mounted on five springs of negligible damping so that the force transmitted is one-eleventh of the impressed force. Assume that the mass of the motor is equally distributed among the five springs. Determine : 1. stiffness of each spring; 2. dynamic force transmitted to the base at the operating speed; and 3. natural frequency of the system	8	CO5	[K_3]
16.	a)	In an epicyclic gear train, an arm carries two gears A and B having 36 and 45 teeth respectively. If the arm rotates at 150 r.p.m. in the anticlockwise direction about the centre of the gear A which is fixed, determine the speed of gear B. If the gear A instead of being fixed, makes 300 r.p.m. in the clockwise direction, what will be the speed of gear B?	8	CO2	[K_2]
	b)	Draw and explain the types of Belt drive with an application.	8	CO5	[K_3]

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