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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)

Fourth Semester, B.E. - Automobile Engineering

Semester End Examination; Sep. / Oct. - 2023

Theory of Machines

Time: 3 hrs *Max. Marks: 100*

Course Outcomes

The Students will be able to:

CO1: Calculate mobility (number of degrees-of-freedom) and enumerate rigid links and types of joints within mechanisms, and to Understand gear mechanism classification and to become familiar with gear standardization and specification in design.

CO2: Explain Terminology of gears and Importance of gear trains and their practical applications.

CO3: Know uses and advantages of belt drives Types and their nomenclature, Relationship between belt tensions commonly used design parameters.

CO4: Draw inversions and determine velocity and acceleration of different mechanisms, and to Calculate loss of power due to friction in various machine elements and Importance of Governors.

CO5: Explain Gyroscopic Effects and Gyroscope in automobile sector.

***Note**: I) **PART - A** is compulsory. **Two** marks for each question.*

*II) **PART - B**: Answer any **Two** sub questions (from a, b, c) for a Maximum of **18 marks** from each unit.*

Q. No.	Questions	Marks	BLs	COs	POs
	I : PART - A	**10**			
1 a.	Define kinematic pair and kinematic chain.	2	L1	CO1	PO1,2
b.	What are the conditions for a body to be in equilibrium under the action of three forces?	2	L1	CO2	PO1,2
c.	What are the laws of solid dry friction?	2	L1	CO3	PO1,2
d.	Why is balancing necessary for rotors of high-speed engines?	2	L1	CO4	PO1,2
e.	What is meant by applied torque and reaction torque?	2	L1	CO5	PO1,2
	II : PART - B	**90**			
	UNIT - I	**18**			
2 a.	With neat sketch, explain any two inversions of double slider crank mechanism.	9	L2	CO1	PO1,2
b.	With the neat sketch, explain construction and working of crank and slotted lever mechanism.	9	L2	CO1	PO1,2
c.	Briefly explain classification of kinematic pair.	9	L2	CO1	PO1,2
	UNIT - II	**18**			
3 a.	In the slider crank mechanism shown in Figure 3a, the crank OA rotates with a uniform speed of 60 r.p.m. Determine the relative velocity of crank and connecting rod, linear velocity of the slider and point Q located on the connecting rod extended as shown. AB = 300 mm, OA = 75 mm, AQ = 50 mm.	18	L3	CO2	PO1,2

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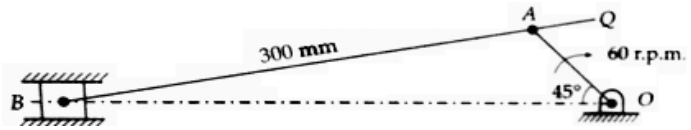

Figure 3a

b. For the static equilibrium of the quick-return mechanism shown in Figure 3b, determine the input torque T_2 to be applied on the link AB for a force of 300 N on the slider D. The dimensions of the various links are OA = 400 mm, AB = 200 mm, OC = 800 mm, CD = 300 mm.

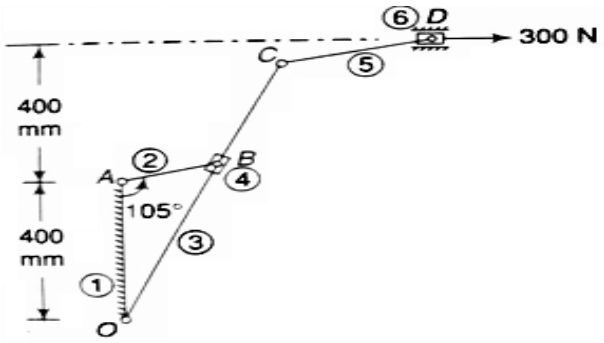

Figure 3b

18 L3 CO2 PO1,2

UNIT - III **18**

4 a. Define friction, types of friction and find the friction between sliding pair with neat sketch. 18

b. With neat sketch, explain different types of follower and explain any three types of motion with displacement diagram. 18

UNIT - IV **18**

5 a. Four masses A, B, C and D carried by a rotating shaft at radii 80 mm, 100 mm, 160 mm and 120 mm respectively are completely balanced. Masses B, C, D are 8 kg, 4 kg and 3 kg respectively. Determine the mass A and the relative angular positions of the four masses if the planes are spaced 500 mm apart. 18 L3 CO4 PO1,2,3,5

5 b. A rotating shaft carries four unbalanced masses 18 kg, 14 kg, 16 kg, and 12 kg at radii 5 cm, 6 cm, 7 cm, and 6 cm respectively. The 2nd, 3rd and 4th masses revolve in planes 8 cm, 16 cm and 28 cm respectively measured from the plane of the first mass and are angularly located at 60º, 135º and 270º respectively measured anticlockwise from the first mass looking from mass end of the shaft. The shaft is dynamically balanced by two masses, both located at 5 cm radii and revolving in planes mid way between those of 1st and 2nd masses and midway between those of 3rd and 4th masses. Determine the magnitudes of the masses and their respective angular positions. 18 L3 CO4 PO1,2,3,5

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UNIT - V **18**

6 a.	Sketch the Hartnell governor. Describe the function and deduce a relation to find the stiffness of the spring.	9	L2	CO5 PO1,2,3,5
b.	Each arm of a porter governor is 200 mm long and is pivoted on the axis of the governor. The radii of rotation of the balls at the minimum and maximum speeds are 120 mm and 160 mm respectively. The mass of the sleeve is 24 kg and each ball is 4 kg. Find the range of speed of the governor. Also find the range of speed if the friction at sleeve is 18 N.	9	L3	CO5 PO1,2,3,5
c.	Each wheel of a motorcycle is of 600 mm diameter and has a moment of inertia of 1.2 $kg.m^2$. The total mass of the motorcycle and the rider is 180 kg and combined center of mass is 580 mm above the ground level when the motorcycle is upright. The moment of inertia of the rotating parts of the engine is 0. 2 $kg.m^2$. The engine speed is 5 times the speed of the wheels and is in the same sense. Determine the angle of wheel necessary when the motorcycle takes a turn of 35 m radius at a speed of 54 km/h.	9	L3	CO5 PO1,2,3,5

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