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

(An Autonomous Institution affiliated to VTU, Belagavi)

Fourth Semester, B.E. - Mechanical Engineering

Semester End Examination; August - 2023

Kinematics of Machinery

Time: 3 hrs *Max. Marks: 100*

Course Outcomes

The Students will be able to:

*CO1: **Identify** various mechanisms, **determine** their degrees of freedom; **describe** various inversions of four bar chain, single and double slider crank chain.*

*CO2: **Analyze** velocity of four bar and slider-crank mechanisms by relative velocity method and Instantaneous centre method. **Analyze** acceleration of four bar and slider-crank mechanisms by relative acceleration method.*

*CO3: **Classify** different types of gears; **Explain** Spur Gear terminology, law of gearing, interference and Back lash. **Derive** expressions for Path of contact, arc of contact and contact ratio. **Solve** numerical problems related to gears.*

*CO4: **Describe** Simple, Compound and Epicyclic gear trains; **Determine** velocity ratio, tooth load and torque in epicyclic gear trains. **Explain** and **calculate** ratio of belt tensions; **Estimate** power transmitted by belt drive; **Analyze** effect of slip, initial and centrifugal belt tension on performance of belt drive.*

*CO5: **Explain** cam and follower types; **Explain** different follower Motions; **Construct** cam profiles for different types of follower motions.*

***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 link and kinematic pair.	2	L1	CO1	PO1
b.	Define absolute and relative motions.	2	L1	CO2	PO1
c.	Define addendum circle and dedendum circle.	2	L1	CO3	PO1
d.	List out the classification of gear train.	2	L1	CO4	PO1
e.	List out the types of Follower-motion.	2	L1	CO5	PO1
	II : PART - B	**90**			
	UNIT - I	**18**			
2 a.	For the kinematic linkages shown in Figure 2 (a) and (b), calculate the following; i) Number of binary links ii) Number of ternary links iii) Degrees of freedom	9	L3	CO1	PO1,2

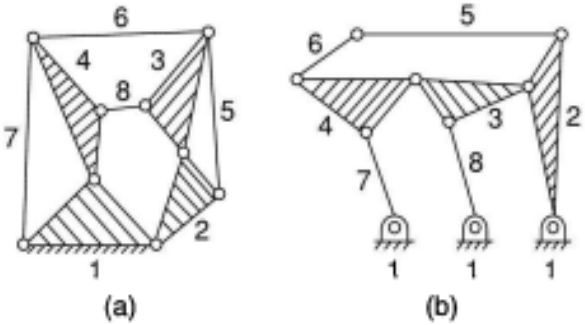

Figure 2

Contd…2

b.	Explain the inversions of four-bar mechanism.	9	L2	CO1	PO2, 3
c.	Explain the following mechanisms; i) Ratchet and Pawl mechanism ii) Toggle mechanism	9	L2	CO1	PO2

UNIT - II **18**

3 a.	Explain linear velocity and angular velocity of a link hinged at one end and free at another end.	4	L2	CO2	PO1,2
b.	In a four-link mechanism, the dimensions of the links are as follows; AB = 50 mm, BC = 66 mm, CD = 56 mm and AD = 100 mm, AD is fixed link. At the instant when DAB = 60°, the link AB has an angular velocity of 10.5 rad/s in the counter-clockwise direction. Determine the; i) Velocity of the point C ii) Velocity of the point E on the link BC when BE = 40 mm iii) Angular velocities of the links BC and CD iv) Velocity of an offset point 'F' on the link BC, if BF = 45 mm, CF = 30 mm and BCF is read clockwise v) Velocity of an offset point 'G' on the link CD, if CG = 24 mm, DG = 44 mm and DCG is read clockwise	14	L3	CO2	PO2,3
c.	For the configuration of a slider-crank mechanism shown in Figure 3 (c), calculate the; i) Acceleration of the slider at B ii) Acceleration of the point E iii) Angular acceleration of the link AB, OA rotates at 20 rad/s counter-clockwise	14	L3	CO2	PO2,3

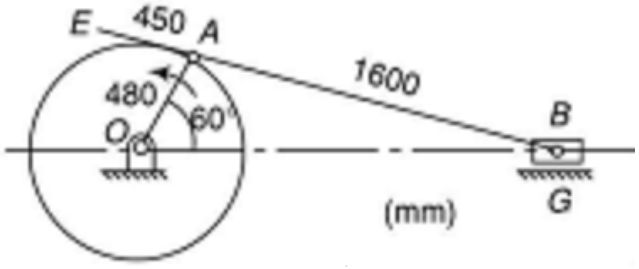

Figure 3 (c)

UNIT - III **18**

4 a.	Draw the schematic diagram of gear tooth; represent the following terms in the diagram and explain each of them; i) Addendum ii) Dedendum iii) Circular pitch iv) Face width v) Clearance	9	L2	CO3	PO2
b.	Derive an expression for path of contact.	9	L2	CO3	PO2,3

Contd…3

c.	Two involute gears in a mesh have a module of 8 mm and a pressure angle of 20°. The larger gear has 57 while the pinion has 23 teeth. If the addenda on pinion and gear wheels are equal to one module, find the i) Contact ratio (the number of pairs of teeth in contact) ii) Angle of action of the pinion and the gear wheels iii) Ratio of the sliding to rolling velocity at the beginning of contact and at the end of contact	9	L3	CO3	PO3

UNIT - IV **18**

5 a.	Explain briefly the following gear trains with neat sketch; i) Compound gear-train ii) Reverted gear train	9	L2	CO4	PO2
b.	An epicyclic gear train is shown in Figure 5 (b). The number of teeth on A and B are 80 and 200. Determine the speed of the arm 'a'; i) if A rotates at 100 rpm clockwise and B at 50 rpm counter-clockwise ii) if A rotates at 100 rpm clockwise and B is stationary	9	L3	CO4	PO2,3

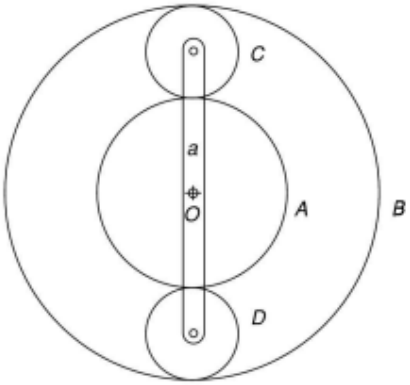

Figure 5 (b)

c.	Explain the following with neat sketch; i) Open belt-drive ii) Crossed belt-drive iii) V belt-drive	9	L2	CO4	PO2

UNIT - V **18**

6 a.	Draw the profile of a cam operating a knife-edge follower having a lift of 30 mm. The cam raises the follower with SHM for 150° of the rotation followed by a period of dwell for 60°. The follower descends for the next 100° rotation of the cam with uniform velocity, again followed by a dwell period. The cam rotates at a uniform velocity of 120 rpm clockwise and has a least radius of 20 mm. What will be the maximum velocity and acceleration of the follower during the lift and the return?	18	L3	CO5	PO2,3

Contd…4

b.	A flat-faced mushroom follower is operated by a uniformly rotating cam. The follower is raised through a distance of 25 mm in 120° rotation of the cam, remains at rest for the next 30° and is lowered during further 120° rotation of the cam. The raising of the follower takes place with cycloidal motion and the lowering with uniform acceleration and deceleration. However, the uniform acceleration is 2/3 of the uniform deceleration. The least radius of the cam is 25 mm which rotates at 300 rpm clockwise. Draw the cam profile and determine the values of; i) The maximum velocity and maximum acceleration during rising ii) Maximum velocity and maximum acceleration and deceleration during lowering of the follower	18	L3	CO5	PO2,3

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