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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; July / August - 2022

Kinematics of Machinery

Time: 3 hrs *Max. Marks: 100*

Course Outcome

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. One question from each unit for maximum of 2 marks.*
*ii) PART-B: Answer any **TWO** sub questions (from a, b, c) from each unit for a Maximum of 18 marks.*

Q. No.	Questions	Marks
	PART - A	**10**
1. a.	Define the terms; i) Mechanism ii) Higher pair	2
b.	Define the following: i) Linear Velocity ii) Angular Acceleration	2
c.	Define Addendum and Dedendum	2
d.	Define Slip and Creep in belt drives	2
e.	List two types of follower motion.	2
	PART - B	**90**
	UNIT - I	**18**
1 a.	Explain with neat sketches i) Crank and slotted quick return motion mechanism ii) Elliptical Trammel	9
b.	With a neat sketch, explain working of a Peaucetlier Straight Line Mechanism and prove that it generates an exact straight line.	9
c.	With a neat sketch, explain working of a Steering Gear Mechanism and derive the condition for the correct steering.	9

Contd…2

UNIT- II **18**

2 a. What is instantaneous centre? Locate all the instantaneous centre of a single slider crank mechanism and show how velocity of the slider and Angular velocity of the connecting rod are determined. 18

b. A four bar chain has a fixed link AD = 1 m, driving crank AB = 0.3 m, follower link CD = 0.6 m and the connecting link BC = 1.2 m. The crank AB rotates at a speed of 300 rpm clockwise with an angular acceleration of 200 rad/s2 in anticlockwise direction. When the angle made by the crank with the fixed link is 135° in anticlockwise direction, determine; 18

i) Angular velocity of the link BC and CD

ii) Angular acceleration of the link BC and CD

iii) Acceleration of B and C

UNIT- III **18**

3 a. State the law of gearing and Derive an expression for length of path of contact of gears 9

b. For two involute gears in mesh, with pinion as the driver the arc of approach is not less than 4.0 times the module. If the pressure angle is 20° and velocity ratio is 2.5 find; 9

i) Least number of teeth on each gear if interference is just avoided

ii) Addendum on the gear in terms of module

c. Two gear wheels mesh externally and are to give a velocity ratio of 3 to 1. The teeth are of involute form; module = 6 mm, addendum = 1m, pressure angle = 20degrees, the pinion rotates at 90 rpm, find; 9

i) Number of teeth on pinion to avoid interference on it and the corresponding number on the wheel

ii) The length of path and arc of contact

iii) The number of pairs of teeth in contact

UNIT- IV **18**

4 a. Two shafts A and B are coaxial. A gear C (50 teeth) is rigidly mounted on shaft A. A compound gear D-E gears with C and an internal gear G. D has 20 teeth and gears with C and E has 35 teeth and gears with an internal gear G. Gear G is fixed and is concentric with the shaft axis. The compound gear D-E is mounted on a pin which projects from an arm keyed to the shaft B. 18

i) Sketch the arrangement

ii) If shaft A rotates at 110rpm, find the speed of shaft B

Contd…3

b. A belt drive is required to transmit 50 kW at 1500rpm of the smaller pulley. The centre distance between the belts is 2mts and coefficient of friction is 0.3. The transmission ratio is 4:1. The centrifugal tension may be taken as 1/3 of the belt tension and allowable stress in the belt may be taken as 2MPa for the belt material. The thickness of the belt is 15mm. The velocity of the belt is 15m/s. Determine; 18

i) Tension in the belt

ii) Maximum tension in the belt

iii) Width of belt

UNIT – V **18**

5 a. Draw the profile of the cam when the roller follower moves with cycloidal motionduring outstroke and return stroke, as given below:

i) Outstroke with maximum displacement of 31.4mm during 180°of cam rotation

ii) Return stroke for the next 150° of cam rotation

iii) Dwell for the remaining 30° of cam rotation. 18

The minimum radius of the cam is 15 mm and the roller diameter of the follower is 10mm. The axis of the roller follower is offset by 10mm towards right from the axis of the cam shaft. Cam rotates in CW direction.

b. A flat faced mushroom follower is raised through a distance of 25 mm is 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. Draw the cam profile assuming clockwise rotation of the cam. 18

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