KUMARAGURU
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B.E DEGREE EXAMINATIONS: MAY 2017

(Regulation 2015)

Fourth Semester

MECHATRONICS ENGINEERING

U15MCT403:Kinematics of machinery

COURSE OUTCOMES

CO1: Select mechanisms to achieve desired motion transformation

CO2: Calculate the position, velocity, acceleration of multi-bar mechanisms by graphical methods

CO3: Construct a cam profile for a given application

CO4: Calculate the primary dimensions of a gear and chose appropriate gear train for a given application

CO5: Solve problem on power transmission and power loss due to friction in various machine elements

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

Answer all the Questions:-

PART A (10 x 1 = 10 Marks)

1.   CO1   [K$_1$]

List I	**List II**
A. Higher kinematic pair	i. Grubler's equation
B. Lower kinematic pair	ii. Line contact
C. Quick return mechanism	iii. Shaper
D. Mobility of a linkage	iv. Surface contact

	A	B	C	D
a)	ii	i	iii	iv
b)	iii	iv	ii	i
c)	ii	iv	i	iii
d)	ii	iv	iii	i

2. The minimum number of links in a single degree-of-freedom planar mechanism with both   CO1   [K$_1$]
   higher and lower kinematic pairs is

   a) 2   b) 3

   c) 4   d) 5

3. Consider the following statements: CO1 [K₁]

    1. The degree of freedom for lower kinematic pairs is always equal to one.

    2. A ball-and-socket joint has 3 degrees of freedom and is a higher kinematic pair

    3. Oldham's coupling mechanism has two prismatic pairs and two revolute pairs.

  Which of the statements given above is/are correct?

a) 1, 2 and 3   b) 1 only

c) 2 and 3   d) 3 only

4. The sense of Coriolis component $2\omega V$ is the same as that of the relative velocity vector V rotated. CO2 [K₁]

a) 45° in the direction of rotation of the link containing the path   b) 45° in the direction opposite to the rotation of the link containing the path

c) 90° in the direction of rotation of the link containing the path   d) 180° in the direction opposite to the rotation of the link containing the path

5. Assertion (A): Hydraulic fluid is one form a link. CO1 [K₂]

Reason (R): A link need not necessarily be a rigid body but it must be a resistant body

a) Both A and R are Individually true and R is the correct explanation of A   b) Both A and R are Individually true but R is not the correct explanation of A

c) A is true but R is false   d) A is false but R is true

6. The centre of gravity of the coupler link in a 4-bar mechanism would experience CO1 [K₁]

a) no acceleration   b) only linear acceleration

c) only angular acceleration   d) both linear and angular accelerations

7. Consider the following follower motions in respect of a given lift, speed of rotation and angle of stroke of a cam: CO3 [K₂]

    1. Cycloidal motion.   2. Simple harmonic motion.

    3. Uniform velocity motion.

  Which one of the following is the correct sequence of the above in the descending order of maximum velocity?

a) 3-2-1   b) 1-2-3

c) 2-3-1   d) 3-1-2

8. Which one of the following sets of elements are quick acting clamping elements for fixtures? CO3 [K₂]

a) Wedge and Cam   b) Cam and Toggle

c) Toggle and Wedge   d) Wedge, Cam and Toggle

9. Assertion (A): Cam of a specified contour is preferred to a cam with a specified follower motion.

   Reason (R): Cam of a specified contour has superior performance. CO3 [K₂]

   a) Both A and R are Individually true and R is the correct explanation of A

   b) Both A and R are Individually true but R is not the correct explanation of A

   c) A is true but R is false

   d) A is false but R is true

10. Pulley in a belt drive acts as CO5 [K₂]

    a) cylindrical pair

    b) turning pair

    c) rolling pair

    d) sliding pair

PART B (10 x 2 = 20 Marks)
(Answer not more than 40 words)

11. Differentiate between machine and mechanism. CO1 [K₂]

12. Write down Kutzhbach criterion to find the mobility of a planar mechanism. CO1 [K₂]

13. Define instantaneous centre. CO2 [K₁]

14. State Corioli's law. CO2 [K₁]

15. What is the significance of pressure angle in cam? CO3 [K₂]

16. What are the major types of cams? CO3 [K₁]

17. State the law of gearing. CO4 [K₁]

18. What is reverted gear train? CO4 [K₁]

19. List down the laws of friction. CO5 [K₁]

20. Define velocity ratio. CO5 [K₁]

Answer any FIVE Questions:-
PART C (5 x 14 = 70 Marks)
(Answer not more than 300 words)

Q.No. 21 is Compulsory

21. A cam is designed for a knife edge follower with following data: Cam lift = 40 mm during 90° of cam rotation with SHM Dwell for the next 30° During the next 60° of cam rotation, the follower returns to original position with SHM Dwell for the remaining 180°. Draw the profile of the cam when the line of stroke is offset 20 mm from the axis of the cam shaft. CO3 [K₆]

22. Explain the working a quick return motion mechanism. Also derive an equation for the ratio of time taken for return stroke and forward strokes. CO1 [K₂]

23. The following data refer to the dimensions of the links of a four-bar mechanism: AB = 50 mm; BC = 66 mm; CD = 56 mm and AD (fixed link) = 100 mm. At the instant when L DAB = 60°, the link AB has an angular velocity of 10.5 rad/s in the counter clockwise direction. Determine the velocity of point C, velocity of point E on the link BC while BE = 40 mm and the angular velocities of the links BC and CD. Also sketch the mechanism and indicate the data.

CO2 [K4]

24. A circular cam operating a flat faced follower has a least diameter of 40 mm. The lift is 12mm and angle of action is 160°. The Speed of rotation is 500 rpm. If the period of acceleration of the follower is 60% of the retardation during the lift, determine the following:

(i) The principal dimensions of the cam

(ii) The acceleration at the main points.

Also determine the maximum acceleration and deceleration during the lift.

CO3 [K6]

25. An epicyclic gear train consists of three gears 1, 2 and 3 as shown in fig. the internal gear 1 has 72 teeth and gear 3 has 32 teeth. The gear 2 meshes with both gear 1 and gear 3 and is carried on an arm A. which rotates about the centre 02 at 20 rpm. If the gear 1 is fixed, determine the speed of gears 2 and 3.

CO4 [K4]
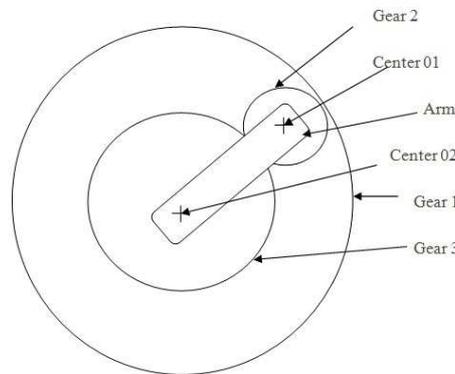
26. List the various friction drives and mention its applications in real world. Also discuss about its advantages and disadvantages of each one.

CO5 [K4]

27. An open belt running over two pulleys 240mm and 600mm diameter connects two parallel shafts 3 metres apart and transmits 4kW from the smaller pulley that rotates at 300 rpm. Coefficient of friction between the belt and the pulley is 0.3 and the safe working tension is 10kN per mm width. Determine minimum width of the belt, initial belt tension and the length of the belt required.

CO5 [K4]

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