



B.E DEGREE EXAMINATIONS: MAY 2018

(Regulation 2015)

Fourth Semester

MECHATRONICS

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.
CO5: Choose appropriate gear train for a given application.
CO6: Solve problems 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. Match the two parts.

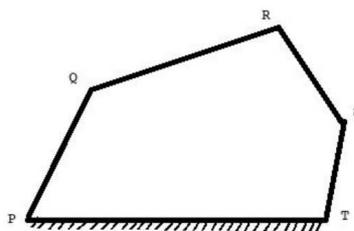
CO3 [K₂]

List I	List II
A. Radial cam	i. Extensively used where more space is available
B. Cylindrical cam	ii. Generally used where space is limited
C. Roller follower	iii. Follower reciprocates in a direction perpendicular to the cam axis
D. Mushroom follower	iv. Follower reciprocates in a direction parallel to the cam axis

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

2. Which type of mechanism is shown below?

CO1 [K₂]



- | | | | |
|----|--------------|----|---------------|
| a) | Constrained | b) | Unconstrained |
| c) | Locked chain | d) | Structure |

3. Select suitable gear for transmitting motion between two parallel shafts. CO4 [K2]
1. Bevel gear 2. Spur gear 3. Helical gear 4. Worm gear
- a) 1,3 b) 1,4
 c) 1,2 d) 2,3
4. The total number of instantaneous centres for a mechanism consisting of n links are CO2 [K2]
- a) $n/2$ b) n
 c) $n-1$ d) $n(n-1)/2$
5. Assertion (A): Simple harmonic motion is a special type of periodic motion or oscillation CO3 [K2]
 motion where the restoring force is directly proportional to the displacement.
 Reason (R): Acts in the direction opposite to that of displacement.
- 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 acceleration of a particle at any instant has two components, radial component and CO2 [K2]
 tangential component. These two components will be
- a) parallel to each other b) perpendicular to each other
 c) inclined at 45° d) inclined at 65°
7. Sequencing the following when the Follower Moves with Simple Harmonic Motion. CO3 [K3]
1. Draw a semi-circle on the follower stroke as diameter.
 2. Divide the angular displacements of the cam during out stroke and return stroke into the same number of equal parts.
 3. Divide the semi-circle into any number of even equal parts.
 4. The displacement diagram is obtained by projecting the points
- a) 2-3-4-1 b) 1-3-2-4
 c) 3-4-2-1 d) 4-1-3-2
8. The maximum efficiency of square threaded power depends upon CO6 [K2]
- a) lead angle of screw b) friction angle
 c) pitch of screw d) nominal diameter of screw
9. Assertion (A): Worm gear drives are typically used for transmission of power between two CO5 [K2]
 non-parallel and non-intersecting shafts.
 Reason (R): Worm gear drives operate silently and smoothly.
- 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. The creep in a belt drive is due to the CO6 [K2]
- a) material of the pulleys b) material of the belt
 c) unequal size of the pulleys d) unequal tension in tight and slack sides of the belt

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

- | | | |
|--|-----|-------------------|
| 11. List the different kinds of kinematic pair. | CO1 | [K ₂] |
| 12. When the four bar chain mechanism transform rotary motion to oscillatory motion. | CO1 | [K ₃] |
| 13. Draw velocity and acceleration diagram for single slider crank mechanism. | CO2 | [K ₂] |
| 14. Prove that how velocity is directly proportional to radius of the link. | CO2 | [K ₃] |
| 15. Define pressure angle in a cam. | CO3 | [K ₂] |
| 16. What is the function of cam? | CO3 | [K ₂] |
| 17. When you will prefer worm and worm wheel for motion transmission. | CO5 | [K ₃] |
| 18. Draw the gear train used in clocks. | CO5 | [K ₂] |
| 19. What is creep in the case of belt? | CO6 | [K ₂] |
| 20. Why are cone clutches better than disc clutches? | CO6 | [K ₂] |

Answer any FIVE Questions:-

PART C (5 x 14 = 70 Marks)
(Answer not more than 300 words)

Q.No. 21 is Compulsory

- | | | |
|--|-----|-------------------|
| 21. Draw the cam profile for following conditions: | CO3 | [K ₃] |
|--|-----|-------------------|

Follower type = Knife edged, in-line; lift = 50mm; base circle radius = 50mm; out stroke with SHM, for 60° cam rotation; dwell for 45° cam rotation; return stroke with SHM, for 90° cam rotation; dwell for the remaining period. Determine max. velocity and acceleration during out stroke and return stroke if the cam rotates at 1000 rpm in clockwise direction.

- | | | | |
|--|-----|-----|-------------------|
| 22. i. Discuss the various types of constrained motion. | (6) | CO1 | [K ₂] |
| ii. Sketch and describe the working of quick return mechanism. Derive an expression for the ratio of times taken in forward and return stroke. | (8) | | |

- | | | |
|---|-----|-------------------|
| 23. PQRS is a four bar chain with link PS fixed. The lengths of the links are PQ = 62.5 mm ; QR = 175 mm ; RS = 112.5 mm ; and PS = 200 mm. The crank PQ rotates at 10 rad/s clockwise. Draw the velocity and acceleration diagram when angle QPS = 60° and Q and R lie on the same side of PS. Find the angular velocity and angular acceleration of links QR and RS.(Fig: 1) | COL | [K _L] |
|---|-----|-------------------|

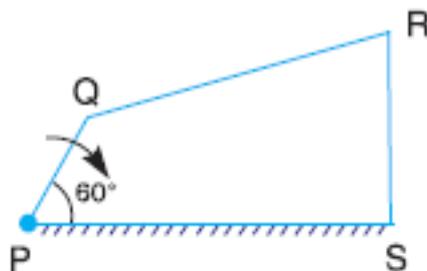


Figure 1

24. i) State and derive the law of gearing. (7) CO4 [K3]
 ii) 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. (7)

25. i) 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? (Fig 2) (10) CO5 [K₃]

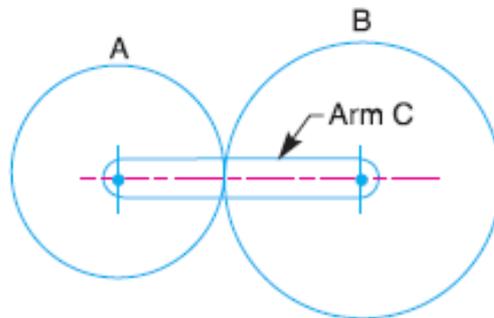


Figure 2

- ii) Illustrate simple and compound gear train. (4)
26. i) A single plate clutch, with both sides effective, has outer and inner diameters 300 mm and 200 mm respectively. The maximum intensity of pressure at any point in the contact surface is not to exceed 0.1 N/mm^2 . If the coefficient of friction is 0.3, determine the power transmitted by a clutch at a speed 2500 r.p.m. (5) CO6 [K₂]
 ii) When coriolis component exist. Derive an expression for the magnitude and direction of coriolis component of acceleration. (9) CO2 [K₃]
27. List various friction drives and select suitable drive system for transmitting motion between two parallel shafts. CO6 [K₃]
