



K. K. Wagh Institute of Engineering Education & Research, Nashik
(An Autonomous Institute From A.Y. 2022-23)

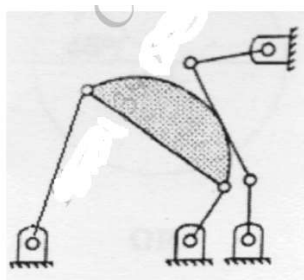
SUMMER-2024	
Exam Seat No.:	
Academic Year:2023-2024	Semester:IV
Class:SY	Program:B.Tech
Branch Code:MEC	Pattern:2022
Name of Course:Theory of Machines	Course Code:MEC222012
Max. Marks:60	Duration:2.30 Hrs.

Instructions: Candidates should read carefully the instructions printed on the Question Paper and on the cover page of the Answer Book, which is provided for their use.

1. This question paper contains 03 page(s).
2. Answer to each new question is to be started on a new page.
3. Assume suitable data wherever required, but justify it.
4. Draw the neat labelled diagrams, wherever necessary.
5. The last columns indicates the Course Outcome and level of Blooms Taxonomy of the Question/sub-question.

Question No. 1 Attempt following Question

- 1a) Determine number of links, number of pairs and obtain degrees of freedom for the given kinematic linkage. (6) CO1



Question No. 2 Attempt following Question

- 2a) In an IC engine mechanism the peripheral velocity of crank pin is constant at 150cm/s and it has instantaneous acceleration of 3750 cm/s². Using analytical method, find out acceleration of piston as well as angular acceleration of connecting rod is normal to the crank and obliquity ratio is 5. (6) CO1, CO2

Question No. 3 Attempt following Question

- 3a) Derive the Freudenstein's equation of four bar mechanism. (6) CO1, CO3

OR

- 3b) Determine the Chebychev spacing for function $y = x^{1.5}$ for the range $0 \leq x \leq 3$ where three precision positions are required. Take $\Delta\theta = 40^\circ$ and $\Delta\phi = 90^\circ$. Find corresponding values of θ and ϕ . (6) CO1, CO3

Assume $\theta_s = 0^\circ$ and $\phi_s = 0^\circ$

- 3c) Determine the length of the link of a four bar mechanism to generate function $y = 5\sin x$. (10) CO1, CO3
 x varies from 0° to 90° . Angle of driving link varies from 30° to 150° . Angle of driven link varies from 60° to 120° . Assume length of fixed link is 100mm. Use three precision positions from Chebychev spacing.

Draw the synthesized mechanism for any position.

OR

- 3d) a) Design a four bar mechanism with input link a, and output link c, angles of θ and ϕ for three successive positions are given in table below: (10) CO1, CO3

Position	1	2	3
θ	55°	25°	-25°
ϕ	110°	40°	-50°

If the grounded link is 40 mm, using Freudenstein's equation find out lengths of other links to satisfy the given positional conditions. Also draw the synthesised mechanism in its second position.

Question No. 4 Attempt following Question

- 4a) Explain with neat sketch? (6) CO1, CO4
 i) Simple Gear train ii) Compound Gear train iii) Reverted Gear train

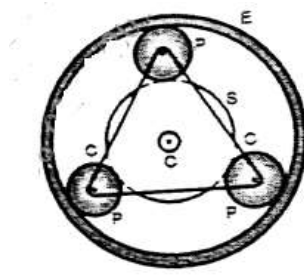
OR

- 4b) Explain following terms used in gears : (6) CO1, CO4
 i) Diametral pitch ii) Dedendum iii) Gear ratio iv) Backlash

- 4c) Two mating gears with module of 6.5 mm have 19 and 47 teeth of 20° pressure angle and standard addendum is equal to one module. Determine: (10) CO1, CO4
 i) The number of pairs of teeth in contact
 ii) The ratio velocity of sliding to rolling velocity at the point of engagement

OR

- 4d) An epicyclic gear train consists of sun wheel S, stationary internal gear E and identical wheels P carried on a star shaped planet carrier C shown in fig. The sizes of different tooth wheels are such that the planet carries C rotates at $1/5$ th of speed of sun wheel S. The minimum number of teeth on any wheels is 16. The driving torque on sun wheel is 100N-m determine (10) CO1, CO4
 i) Number of teeth on different wheels of train.
 ii) Torque necessary to keep the internal gear stationary.



Question No. 5 Attempt following Question

- 5a) Draw the displacement, velocity and acceleration diagram for a follower when it moves with uniform acceleration and retardation. (6) CO1, CO5

OR

- 5b) Draw the displacement, velocity and acceleration diagram for a follower when it moves with cycloidal motion. (6) CO1, CO5

- 5c)) A cam, with a minimum radius of 25 mm, rotating clockwise at a uniform speed is to be designed to give a roller follower, at the end of a valve rod, motion described below : (10) CO1, CO5

1. To raise the valve through 50 mm during 120° rotation of the cam ;
2. To keep the valve fully raised through next 30° .
3. To lower the valve during next 60° ; and
4. To keep the valve closed during rest of the revolution i.e. 150° . The displacement of the valve, while being raised and lowered, is to take place with simple harmonic motion. The diameter of roller is 20mm. Determine the maximum velocity and acceleration of the valve rod when the cam shaft rotates at 100 rpm.

OR

- 5d) A cam is to be designed for a knife edge follower with the following data : (10) CO1, CO5

1. Cam lift = 40 mm during 90° of cam rotation with simple harmonic motion.
2. Dwell for the next 30° .
3. During the next 60° of cam rotation, the follower returns to its original position with simple harmonic motion.
4. Dwell during 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. The radius of the base circle of the cam is 40 mm. Determine the maximum velocity and acceleration of the follower during its ascent and descent, if the cam rotates at 240 rpm

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