K. K. Wagh Institute of Engineering Education & Research, Nashik

(An Autonomous Institute From A.Y. 2022-23)

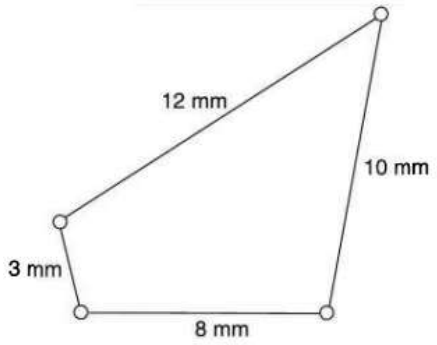
SUMMER-2024	
Exam Seat No.:	
Academic Year:2023-2024	Semester:IV
Class:SY	Program:B.Tech
Branch Code:MEC	Pattern:2022
Name of Course:Theory of Machines	Course Code:MEC222012
Max. Marks:60	Duration:2.30 Hrs.

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) Find all the inversion of the chain given below. (6) CO1



Question No. 2 Attempt following Question

2a) What is the loop closure equation ? Derive the same for the Four bar mechanism. (6) CO1, CO2

Question No. 3 Attempt following Question

3a) Explain the following terms related to kinematic synthesis with the help of neat sketches. (6) CO1, CO3

1) Function generation 2) Path generation 3) Motion generation (Body guidance)

3b) Find the three precision points in the interval of 40° to 120° by using the graphical method of Chebychev spacing. (6) CO1, CO3

3c) Synthesize a four bar mechanism to coordinate 3 positions of the input and output links as follows: (10) CO1, CO3

$\theta 1 = 20°$, $\theta 2 = 35°$, $\theta 3 = 50°$ and $\phi 1 = 35°$, $\phi 2 = 45°$, $\phi 3 = 60°$. Assume length of the fixed link as 10 cm. Draw the synthesized mechanism in its second position.

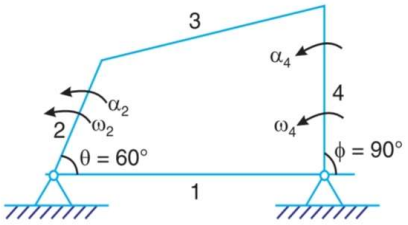
OR

3d) Synthesize a four bar linkage , as shown in figure, using Freudenstein's equation to satisfy in one of its positions. The specification of position θ, velocity ω and acceleration α are as follows: (10) CO1, CO3

$\theta = 60°$, $\omega_2 = 5$ rad/s , $\alpha_2 = 2$ rad/s^2

$\phi = 90°$, $\omega_4 = 2$ rad/s , $\alpha_4 = 7$ rad/s^2.

Assume length of the input link as 1 unit.



Question No. 4 Attempt following Question

4a) Compare Cycloidal and Involute gear tooth profile. (6) CO1, CO4

OR

4b) Derive an expression for the length of path of approach of involute gears. (6) CO1, CO4

4c) Two gears in mesh have a module of 10 mm and a pressure angle of 25°. The pinion has 20 teeth and the gear has 52 teeth. The addendum on both the gears is equal to one module. Determine (10) CO1, CO4

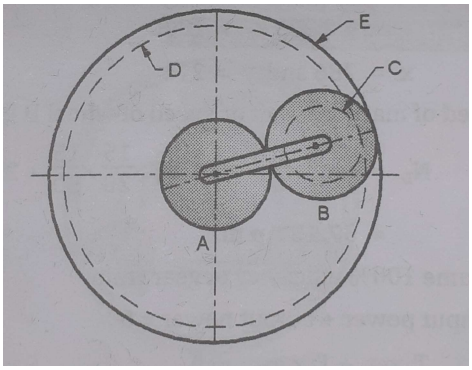
i) the number of pairs of teeth in contact

ii) the angle of action of the pinion and the gear wheel

iii) the ratio of sliding to rolling velocity at (a) the beginning of contact (b) the pitch point (c) the end of contact

OR

4d) Figure shows an epicyclic gear train. Pinion A has 15 teeth and is rigidly fixed to the motor shaft. The wheel B has 20 teeth and gears with A and also with the annular fixed wheel E. Pinion C has 15 teeth and is integral with B (B, C being a compound gear wheel). Gear C meshes with annular wheel D, which is keyed to the machine shaft. Arm rotates about the same shaft on which A is fixed and carries the compound wheel B,C. If the motor runs at 1000 r.p.m., find the speed of the machine shaft. Find the torque exerted on the machine shaft, if the motor develops a torque of 100 Nm. (10) CO1, CO4



Question No. 5 Attempt following Question

5a)	A circular disc cam of diameter 120 mm with its centre displaced 40 mm from the camshaft is used with a flat surface follower. The line of action of the follower is vertical and passes through the shaft axis. The mass of the follower is 3 kg and is pressed downward with a spring of stiffness 5 N/mm. In the lowest position, the spring force is 60 N. Derive an expression for the acceleration of the follower as a function of cam rotation from the lowest position of the follower. Also, find the speed at which the follower begins to lift from the cam surface.	(6)	CO1, CO5

OR

5b)	Derive expression for displacement, velocity and acceleration for S.H.M. (Simple Harmonic Motion) of follower. Draw displacement diagram, velocity diagram and acceleration diagram for S.H.M.	(6)	CO1, CO5
5c)	A cam drives a roller follower. (Roller diameter = 3 cm) During the first 90° rotation of the cam follower moves outward through a distance of 4 cm with S.H.M. The follower dwells during the next 90° cam rotation. During the next 90° cam rotation, the follower moves inwards with S.H.M. Follower dwells for the next 90° cam rotation. (i) Draw cam profile. (ii) Calculate the maximum values of velocity, acceleration and retardation when cam rotates at 10 rad/s. Take the minimum radius of cam as 6 cm.	(10)	CO1, CO5

OR

5d)	Use the following data to draw a cam profile in which a knife edged follower is raised with Uniform acceleration and deceleration and is lowered with Simple Harmonic Motion (S.H.M.): Least radius of cam = 60 mm, Lift of follower = 45 mm, Angle of ascent = 60°, Angle of dwell between ascent and descent = 40°, Angle of descent = 75° If the cam rotates at 180 rpm, determine the maximum velocity and acceleration during ascent and descent	(10)	CO1, CO5

XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX