



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

WINTER-2025	
Exam Seat No.:	
Academic Year:2025-2026	Semester:IV
Class:SY	Program:B.Tech
Branch Code:ROB	Pattern:2023
Name of Course:Design of Machines and Mechanism	Course Code:2312213
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 2 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.

Marks CO

Question No. 1

Three masses m_1 , m_2 , and m_3 are attached to a shaft and rotate in the same plane.

- $m_1 = 10$ kg at a radius of 100 mm
- $m_2 = 8$ kg at a radius of 150 mm
- $m_3 = 5$ kg at a radius of 200 mm

The angular positions of the masses from m_1 are:

- m_2 is at 90°
- m_3 is at 210°

A fourth mass m_4 is to be added at a radius of 120 mm to achieve static balance.

Find:

1. The magnitude of the balancing mass m_4 .
2. Its angular position relative to m_1 .

1a) (6) CO1

Question No. 2

2a) i) What is an epicyclic gear train? (6) CO2

ii) In an epicyclic gear train, an arm (A) carries a planet gear (P) which meshes with a fixed sun gear (S) and an internal ring gear (R).

- The Sun Gear (S) has 40 teeth and is fixed.

- The Planet Gear (P) has 20 teeth.
 - The Arm (A) rotates at 100 rpm clockwise.
- Find the speed and direction of the Ring Gear (R).

Question No. 3

- 3a) What is the difference between forward kinematics and inverse kinematics in robotics? Explain with a simple example for a 2-link arm. (8) CO3

OR

- 3b) What is a singularity in a robotic manipulator? Explain its physical meaning (what happens to the robot) and why it is usually a problem that should be avoided in robot programming. (8) CO3
- 3c) What are the main components of a robotic manipulator? Briefly describe the function of links, joints, and the end-effector. (8) CO3

OR

- 3d) What is trajectory planning for a robot? Explain the difference between point-to-point motion and continuous path motion. (8) CO3

Question No. 4

- 4a) What is dynamic balancing? Explain its importance in high-speed machinery and list the two conditions that must be met to achieve it. (8) CO4

OR

- 4b) What is optimization in machine design? Briefly explain the main steps involved in an optimization problem. (8) CO4
- 4c) What is the difference between static balancing and dynamic balancing? Explain why a rotor that is statically balanced might *not* be dynamically balanced. (8) CO4

OR

- 4d) What is D'Alembert's Principle? Explain how it helps convert a problem in dynamics into a problem in statics. Define the terms "inertia force" and "inertia torque". (8) CO4

Question No. 5

- 5a) What are the different types of CAD models? Explain the main advantages of using 3D solid modeling over 2D drafting for designing a machine part. (8) CO5

OR

- 5b) What are the key factors for a successful machine design? Explain how modern CAD software helps designers validate a design (using simulation) before it is built. (8) CO5
- 5c) What is assembly modeling in CAD? Explain the basic steps to create an assembly and how you would use it to perform a kinematic simulation to check the motion of the parts. (8) CO5

OR

- 5d) Pick a common machine you are familiar with. Describe two design challenges the engineers might have faced and how CAD tools could have helped solve them. (8) CO5

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