

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- 5 SEMESTER – OLD PAPER – S22 TO S25 – QUESTION BANK

Subject Name & Code:

Control Engineering- 3151908

Chapter 1: Basic Concepts of Control Systems

Repeated Questions:

1. **Compare Open Loop and Closed Loop Control Systems with examples, advantages, and disadvantages.**
 - **Appeared in:** SUM 2023 (03 marks), WIN 2023 (04 marks), SUM 2022 (04 marks), SUM 2025 (04 marks), WIN 2024 (04 marks).
 - **Why Important:** This is a fundamental, high-probability question. Be ready to write a detailed comparison table.
2. **Explain the working of a Closed-Loop Control System with a suitable example (e.g., Air Conditioner, Traffic Control).**
 - **Appeared in:** SUM 2023 (04 marks - Traffic Signals), SUM 2025 (07 marks - Air Conditioner).
3. **Define: Manipulated Variable, Controlled Variable, Disturbance.**
 - **Appeared in:** SUM 2025 (03 marks), WIN 2024 (03 marks).

Other Important Questions:

4. **What are the advantages and disadvantages of open-loop systems?** (WIN 2022 - 04 marks)
5. **Draw a general block diagram of an Automatic Control System.** (SUM 2023 - 03 marks)
6. **Define Servomechanism and Regulator.** (From Syllabus Topic List)
7. **Classify control systems and explain a time-variant system with an example.** (WIN 2024 - 03 marks)

Chapter 2: Modelling of Control Systems

Repeated Questions:

1. **Define Transfer Function and state its properties/characteristics.**
 - **Appeared in:** SUM 2024 (03 marks), WIN 2023 (03 marks), WIN 2024 (04 marks).
2. **Using Block Diagram Reduction Technique, find the overall transfer function $C(s)/R(s)$ for a given block diagram.**
 - **Appeared in:** WIN 2023 (07 marks), SUM 2022 (07 marks), WIN 2024 (07 marks). *This is a guaranteed numerical problem.*
3. **Using Mason's Gain Formula, find the transfer function for a given Signal Flow Graph.**
 - **Appeared in:** SUM 2024 (07 marks), WIN 2022 (07 marks), WIN 2023 (07 marks - OR part), WIN 2024 (07 marks - OR part). *Another guaranteed numerical problem.*
4. **Explain the Analogies between Mechanical and Electrical Systems (Force-Voltage, Force-Current).**
 - **Appeared in:** SUM 2023 (07 marks), WIN 2024 (07 marks).
5. **Derive the Transfer Function for a Spring-Mass-Damper system.**
 - **Appeared in:** SUM 2023 (07 marks).

Other Important Questions:

6. **Define for a Signal Flow Graph: Node, Path, Branch, Loop, Non-touching loops, Self-loop.** (SUM 2025 - 03 marks)
7. **Compare Block Diagram and Signal Flow Graph.** (WIN 2022 - 04 marks)
8. **Obtain the transfer function for a given Electrical Circuit / Mechanical System.** (SUM 2025 - 07 marks, SUM 2022 - 07 marks)
9. **Explain the linearization of non-linear systems.** (SUM 2024 - 03 marks)
10. **Obtain the mathematical model for a Thermal System.** (SUM 2022 - 04 marks, WIN 2024 - 07 marks - OR part)

Chapter 3: Time Domain Analysis

Repeated Questions:

1. **Define and Explain Transient Response Specifications for a second-order system: Rise Time (t_r), Peak Time (t_p), Maximum Overshoot (M_p), Settling Time (t_s).**
 - **Appeared in:** SUM 2023 (04 marks), WIN 2023 (03 marks), SUM 2024 (03 marks), SUM 2022 (04 marks). *Often asked with a sketch.*
2. **Explain Standard Test Signals (Impulse, Step, Ramp, Parabolic) with their plots and transfer functions.**
 - **Appeared in:** WIN 2022 (03 marks), SUM 2025 (04 marks).
3. **Using Routh-Hurwitz Stability Criterion, determine the range of 'K' for stability for a given characteristic equation.**
 - **Appeared in:** SUM 2023 (07 marks - design problem), WIN 2022 (04 marks), SUM 2025 (07 marks), WIN 2024 (04 marks). *A very common numerical.*
4. **For a given second-order system (e.g., $G(s) = \omega_n^2 / (s^2 + 2\zeta\omega_n s + \omega_n^2)$), calculate t_r , t_p , M_p , t_s for a unit step input.**
 - **Appeared in:** SUM 2024 (07 marks), SUM 2022 (07 marks). *A direct numerical application.*

Other Important Questions:

5. **Discuss the effect of damping ratio (ζ) on pole locations and response of a second-order system.** (SUM 2022 - 03 marks)
6. **Define Underdamped, Overdamped, and Critically damped systems.** (WIN 2024 - 03 marks - OR part)
7. **Obtain the unit-step response of a first-order system and discuss steady-state error.** (SUM 2024 - 07 marks - OR part)
8. **Define Steady State Error and Time Constant.** (WIN 2023 - 04 marks - OR part)
9. **Explain the effect of adding Integral control to a proportional control system.** (WIN 2024 - 04 marks - OR part)
10. **Sketch the Root Locus for a given open-loop transfer function (e.g., $G(s) = K / (s(s+1)(s+2))$).** (SUM 2023 - 07 marks - OR part, SUM 2025 - 07 marks - OR part) *Often considered part of both Time and Frequency Domain.*

Chapter 4: Frequency Domain Analysis

Repeated Questions:

1. **Define and Explain Phase Margin and Gain Margin. State their importance.**
 - **Appeared in:** WIN 2022 (07 marks), WIN 2023 (07 marks), WIN 2024 (03 marks).
2. **Explain the Nyquist Stability Criterion in detail.**
 - **Appeared in:** WIN 2023 (04 marks), SUM 2025 (04 marks).
3. **Draw the Bode Plot for a given transfer function and determine Gain Margin, Phase Margin, and stability.**
 - **Appeared in:** SUM 2023 (07 marks), SUM 2022 (07 marks), SUM 2025 (07 marks - OR part). *A key graphical/numerical problem.*
4. **Define and Explain Lead Compensation and Lag Compensation.**
 - **Appeared in:** SUM 2025 (03 marks).

Other Important Questions:

5. **State the advantages of Frequency Response Analysis.** (SUM 2022 - 03 marks, WIN 2023 - 03 marks)
6. **Explain Relative Stability from the Nyquist Plot / Frequency Response.** (SUM 2024 - 04 marks - OR part)
7. **For a second-order system with given % overshoot and period of oscillation, determine Resonant Peak (M_r), Resonant Frequency (ω_r), and Bandwidth.** (SUM 2022 - 07 marks - OR part)
8. **Explain the effects and limitations of Lag Compensation.** (SUM 2022 - 04 marks)

Chapter 5: PID Controllers

Repeated Questions:

1. **Explain the Tuning of a PID Controller (e.g., Ziegler-Nichols method).**
 - **Appeared in:** SUM 2024 (04 marks), SUM 2025 (07 marks), WIN 2024 (03 marks).
2. **Determine the transfer functions of P, PI, and PID controllers.**
 - **Appeared in:** SUM 2025 (04 marks).
3. **Describe the need for tuning PID controllers.** (SUM 2025 - 03 marks - OR part)

Other Important Questions:

1. **Compare Hydraulic and Pneumatic Control Systems.**
 - **Appeared in:** SUM 2023 (03 marks), SUM 2022 (04 marks), SUM 2025 (04 marks), WIN 2024 (04 marks). *Very frequent question.*
2. **Explain the working of a Hydraulic PI / PID Controller with a neat sketch and derive its transfer function.**
 - **Appeared in:** SUM 2024 (07 marks), WIN 2023 (07 marks), SUM 2022 (07 marks - OR part), WIN 2024 (07 marks).
3. **List the sources of hydraulic power.**
 - **Appeared in:** WIN 2022 (04 marks), SUM 2025 (03 marks).

Other Questions from this Chapter:

4. **Draw a basic hydraulic circuit with standard symbols and label it.** (WIN 2022 - 03 marks)
5. **Explain a Hydraulic Proportional plus Derivative (PD) controller.** (SUM 2024 - 04 marks)
6. **Draw a generalized hydraulic control system and state the function of each component.** (WIN 2023 - 04 marks - OR part)

Chapter 6: Hydraulic Control Systems

Repeated Questions:

1. **Compare Hydraulic and Pneumatic Control Systems.**
 - **Appeared in:** SUM 2023 (03 marks), SUM 2022 (04 marks), SUM 2025 (04 marks), WIN 2024 (04 marks). *Very frequent question.*
2. **Explain the working of a Hydraulic PI / PID Controller with a neat sketch and derive its transfer function.**
 - **Appeared in:** SUM 2024 (07 marks), WIN 2023 (07 marks), SUM 2022 (07 marks - OR part), WIN 2024 (07 marks).
3. **List the sources of hydraulic power.**
 - **Appeared in:** WIN 2022 (04 marks), SUM 2025 (03 marks).

Other Important Questions:

4. **Draw a basic hydraulic circuit with standard symbols and label it.** (WIN 2022 - 03 marks)
5. **Explain a Hydraulic Proportional plus Derivative (PD) controller.** (SUM 2024 - 04 marks)
6. **Draw a generalized hydraulic control system and state the function of each component.** (WIN 2023 - 04 marks - OR part)

Chapter 7: Pneumatic Control Systems

Repeated Questions:

1. **Explain the working of a Pneumatic Nozzle-Flapper Amplifier with a neat sketch and its characteristic curve.**
 - **Appeared in:** SUM 2024 (07 marks - OR part), WIN 2022 (04 marks), SUM 2025 (07 marks), WIN 2024 (03 marks).
2. **List and explain various components of a pneumatic control system (including FRL unit).**
 - **Appeared in:** SUM 2023 (04 marks - OR part), SUM 2025 (03 marks - OR part).
3. **Explain a Force-Balance type (P or PI) Pneumatic Controller.**
 - **Appeared in:** SUM 2025 (04 marks - OR part), WIN 2024 (07 marks - OR part).

Other Important Questions:

4. **Explain a pneumatic actuating valve.** (WIN 2023 - 03 marks)
5. **Write about pneumatic power sources.** (SUM 2023 - 03 marks - OR part)
6. **Sketch and explain a pneumatic nozzle-flapper amplifier system.** (From Syllabus Topic List)
