

GUJARAT TECHNOLOGICAL UNIVERSITY

BE-7 SEMESTER – OLD PAPER – S22 TO S25 – QUESTION BANK

Subject Name & Code:

Automation in Manufacturing- 3171922

Chapter 1: Introduction to Automation

Repeated Questions:

1. **What is Automation? Explain its types/classification.**
 - **Appeared in:** Summer 2023 (Q1a, 03 Marks), Summer 2024 (Q1a,c, 03+07 Marks), Winter 2022 (Q1a, 03 Marks), Winter 2023 (Q1c, 07 Marks), Summer 2022 (Q2c OR, 07 Marks).
 - **Weightage:** Very High (Appeared in 5/6 papers).
 - **Notes:** This is a fundamental definition question. Be prepared to list and describe fixed, programmable, and flexible automation.
2. **Explain the USA Principle.**
 - **Appeared in:** Summer 2023 (Q1c, 07 Marks), Winter 2023 (Q1a, 03 Marks), Summer 2022 (Q1b, 04 Marks).
 - **Weightage:** High.
 - **Notes:** Understand the meaning of Understand, Simplify, and Automate. Often asked for 3-4 marks, but can be expanded to 7 marks.
3. **List the reasons/feasibility for automation.**
 - **Appeared in:** Summer 2024 (Q1a,b, 03+04 Marks), Winter 2023 (Q1b, 04 Marks), Summer 2022 (Q1a, 03 Marks).
 - **Weightage:** High.
 - **Notes:** A straightforward list-based question. Focus on reasons like increasing productivity, reducing cost, improving quality, and ensuring safety.
4. **Explain Ten Strategies for Automation and Process Improvement.**
 - **Appeared in:** Summer 2023 (Q1c, 07 Marks), Summer 2022 (Q1c, 07 Marks), Summer 2025 (Q2c OR, 07 Marks).
 - **Weightage:** High.
 - **Notes:** A detailed 7-mark question. Strategies include specialization, combination, simultaneous operations, etc.
5. **Explain Automation Migration Strategies.**
 - **Appeared in:** Summer 2025 (Q1c, 07 Marks).
 - **Weightage:** Medium (New emphasis in 2025).
 - **Notes:** Requires explanation of Phase 1 (Manual), Phase 2 (Automated), Phase 3 (Automated Integrated) with a diagram.

Other Important Questions:

1. **Define automated manufacturing system. Enlist its various elements.**

- **Appeared in:** Summer 2025 (Q1a, 03 Marks).
 - **Notes:** Core definition question.
2. **What are the levels of automation?**
- **Appeared in:** Summer 2022 (Q2c OR, 07 Marks).
 - **Notes:** Discuss levels from device to enterprise level.
3. **Interpret Modular automations and its applications.**
- **Appeared in:** Winter 2022 (Q1b, 04 Marks).
 - **Notes:** Relates to Chapter 7.
4. **Explain in detail Automated manufacturing system with a diagram.**
- **Appeared in:** Winter 2022 (Q1c, 07 Marks), Winter 2024 (Q1c, 07 Marks).
 - **Notes:** A comprehensive question combining definition, elements, and a schematic.
5. **Describe the various types of sensors used in automation. Suggest sensors used in smartphones.**
- **Appeared in:** Summer 2025 (Q1b, 04 Marks).
 - **Notes:** Links basic sensor types (proximity, position, etc.) to a practical application.

Chapter 2: Group Technology (GT)

Repeated Questions:

1. **Explain Group Technology with a suitable example.**
 - **Appeared in:** Summer 2023 (Q2a, 03 Marks), Summer 2024 (Q2b, 04 Marks), Winter 2022 (Q2a, 03 Marks), Winter 2023 (Q2a, 03 Marks), Winter 2024 (Q2a, 03 Marks).
 - **Weightage:** Very High (Appeared in 5/6 papers).
 - **Notes:** The most fundamental question of this chapter. Always provide a clear example (e.g., grouping similar shafts, gears).
2. **Explain the OPITZ/OPTZ parts classification and coding system.**
 - **Appeared in:** Summer 2023 (Q2c, 07 Marks), Summer 2024 (Q2c OR, 07 Marks), Winter 2023 (Q2c, 07 Marks), Summer 2022 (Q2c, 07 Marks).
 - **Weightage:** Very High.
 - **Notes:** A classic 7-mark question. Be thorough with the 9-digit code structure (1-5: Form, 6-9: Supplementary) and an example.
3. **Explain types of part classification and coding systems.**
 - **Appeared in:** Summer 2024 (Q2c, 07 Marks), Summer 2025 (Q2c, 07 Marks).
 - **Weightage:** High.
 - **Notes:** Broader question covering systems like OPITZ, KK-3, DCLASS, etc.
4. **Describe the Rank Order Clustering (ROC) technique.**
 - **Appeared in:** Winter 2022 (Q2c OR, 07 Marks), Winter 2023 (Q2c OR, 07 Marks), Winter 2024 (Q2c, 07 Marks), Summer 2025 (Q2a, 03 Marks).
 - **Weightage:** High.
 - **Notes:** A mathematical/matrix-based method for forming part families. Know the step-by-step procedure.

Other Important Questions:

1. **What are part families? Explain methods of grouping parts.**
 - **Appeared in:** Summer 2022 (Q2a, 03 Marks).
 - **Notes:** Methods include visual inspection, part classification & coding, production flow analysis.
2. **What is meant by “Key machine” in cellular manufacturing? Justify with a sketch.**
 - **Appeared in:** Summer 2025 (Q2b, 04 Marks).
 - **Notes:** A specific concept; the key machine is the most critical or expensive machine in a cell.
3. **Explain cellular manufacturing system.**
 - **Appeared in:** Summer 2024 (Q3b, 04 Marks), Winter 2022 (Q3b, 04 Marks), Winter 2023 (Q2b, 04 Marks).
 - **Notes:** Often a 4-mark question. It's the application of GT.
4. **Explain basic code structures used in parts classification.**
 - **Appeared in:** Summer 2023 (Q2c OR, 07 Marks).
 - **Notes:** Focuses on hierarchical (monocode), chain-type (polycode), and hybrid structures.
5. **State the objective and applications of rank order clustering (ROC).**
 - **Appeared in:** Summer 2025 (Q2a, 03 Marks).
 - **Notes:** The objective is to form machine-component cells to minimize material handling.

Chapter 3: Flexible Manufacturing Systems (FMS)

Repeated Questions:

1. **What is FMS? Explain its components/elements.**
 - **Appeared in:** Summer 2023 (Q3c, 07 Marks), Summer 2024 (Q4a, 03 Marks), Winter 2023 (Q3a, 03 Marks), Summer 2022 (Q3c, 07 Marks), Summer 2025 (Q3a, 03 Marks).
 - **Weightage:** Very High.
 - **Notes:** Must be able to list and explain workstations, MHSS, and computer control system.
2. **List applications and advantages of FMS.**
 - **Appeared in:** Winter 2022 (Q3a, 03 Marks), Winter 2023 (Q3a OR, 03 Marks), Summer 2024 (Q3c OR, 07 Marks), Winter 2024 (Q3a OR, 03 Marks).
 - **Weightage:** High.
 - **Notes:** A very common question.
3. **Explain the types of flexibilities in FMS.**
 - **Appeared in:** Summer 2023 (Q3a, 03 Marks), Summer 2023 (Q3a OR, 03 Marks), Summer 2025 (Q3b, 04 Marks), Winter 2024 (Q3b, 04 Marks).
 - **Weightage:** High.
 - **Notes:** Know at least 5-6 types: Machine, Production, Mix, Volume, Expansion, Routing flexibility.
4. **Explain Automated Guided Vehicles (AGVs) / Automated Storage and Retrieval Systems (ASRS) associated with FMS.**
 - **Appeared in:** Winter 2023 (Q3c, 07 Marks), Winter 2024 (Q3c OR, 07 Marks), Summer 2025 (Q3a OR, 03 Marks).
 - **Weightage:** Medium-High.
 - **Notes:** These are key components of the FMS material handling system.

Other Important Questions:

1. **Differentiate between fixed and flexible automation.**
 - **Appeared in:** Summer 2022 (Q3c, 07 Marks).
 - **Notes:** A classic comparison question.
2. **Elaborate FMS with a diagram.**
 - **Appeared in:** Winter 2022 (Q2b, 04 Marks), Winter 2024 (Q2b, 04 Marks).
 - **Notes:** Requires a schematic layout showing machines, AGVs, and control.
3. **Illustrate types of FMS and its components with a sketch.**
 - **Appeared in:** Winter 2022 (Q3c, 07 Marks).
 - **Notes:** Covers In-line, Loop, Ladder, and Open-field types.
4. **What is meant by quantitative analysis of FMS? Explain any one mathematical model.**
 - **Appeared in:** Summer 2025 (Q3c, 07 Marks).

- **Notes:** This is a numerical/problem-solving question. Be prepared for models on performance measures like production rate or number of AGVs. **This is important.**

5. **Write a short note on effect of automation on economics.**

- **Appeared in:** Summer 2024 (Q3c, 07 Marks), Winter 2022 (Q3c OR, 07 Marks).
- **Notes:** Bridges Chapter 3 and Chapter 8.

Numerical Question Alert (From Summer 2025 Paper, Q4c)

This is a crucial numerical problem. I will detail it here as requested.

- **Question (Summer 2025, Q4c):** A restaurant with the brand “DCBA” pizza employs a transfer machine with 10 stations for making pizza topping, with an average production time of 1.10 minutes. When a line stop occurs due to sensor failure, the average downtime is estimated as 6.5 minutes. Determine (a) the frequency of line stops (stops per cycle), (b) the average pizza production rate in pieces per hour, (c) cycle time, and (d) pizza-carrying line efficiency assuming proportion downtime as 42%.

Chapter 4: Pneumatic and Hydraulic Systems

Repeated Questions:

1. **Enlist/Explain applications of pneumatic and hydraulic systems in automation.**
 - **Appeared in:** Summer 2023 (Q4c, 07 Marks), Winter 2022 (Q4a, 03 Marks), Winter 2023 (Q3b OR, 04 Marks), Summer 2024 (Q4c OR, 07 Marks), Summer 2025 (Q4a, 03 Marks).
 - **Weightage:** Very High.
 - **Notes:** Hydraulics for high force (presses, lifts), Pneumatics for fast, clean motion (clamping, packaging).
2. **Enlist limitations of pneumatics and hydraulic systems.**
 - **Appeared in:** Summer 2023 (Q4a OR, 03 Marks), Summer 2024 (Q4b, 04 Marks), Summer 2022 (Q4b, 04 Marks).
 - **Weightage:** High.
 - **Notes:** Common limitations: Hydraulics (leakage, maintenance), Pneumatics (low force, compressibility).
3. **Explain hydraulic/pneumatic system components.**
 - **Appeared in:** Winter 2022 (Q4c, 07 Marks), Winter 2023 (Q4c OR, 07 Marks), Summer 2024 (Q4b OR, 04 Marks).
 - **Weightage:** Medium.
 - **Notes:** Know the key components: Reservoir, Pump/Compressor, Valves, Actuators (Cylinders, Motors), piping.
4. **Explain various types of actuators (including rotary).**
 - **Appeared in:** Winter 2023 (Q3c OR, 07 Marks), Summer 2025 (Q3c OR, 07 Marks), Winter 2024 (Q3c, 07 Marks).
 - **Weightage:** Medium-High.
 - **Notes:** Linear actuators (cylinders), Rotary actuators (vane motors, gear motors). Explain any two in detail.

Other Important Questions:

1. **What is an actuator? Enlist different hydraulic actuators with functions.**
 - **Appeared in:** Summer 2023 (Q4a, 03 Marks).
 - **Notes:** Actuators convert fluid power to mechanical motion. List linear and rotary types.
2. **Illustrate Hydraulic actuators with a sketch.**
 - **Appeared in:** Winter 2022 (Q4b, 04 Marks).
 - **Notes:** Requires diagrams of single/double-acting cylinders.
3. **Explain basic components used in a pneumatic automation system.**
 - **Appeared in:** Summer 2022 (Q4a OR, 03 Marks).
 - **Notes:** Similar to hydraulic components but for air: Compressor, FRL unit, valves, cylinders.

Chapter 5: Industrial Robotics and Mechatronics

Repeated Questions:

1. **List and explain different configurations of industrial robots.**
 - **Appeared in:** Summer 2023 (Q5a OR, 03 Marks), Summer 2024 (Q5a OR, 03 Marks), Summer 2022 (Q4a, 03 Marks).
 - **Weightage:** High.
 - **Notes:** Must know: Cartesian, Cylindrical, Spherical/Polar, SCARA, Articulated. Explain Polar configuration as specifically asked.
2. **Differentiate between End Effectors and Manipulators.**
 - **Appeared in:** Winter 2023 (Q4a, 03 Marks), Winter 2024 (Q4a OR, 03 Marks).
 - **Weightage:** Medium.
 - **Notes:** Manipulator is the arm; End Effector is the tool (gripper, welder) attached to it.
3. **Explain Robot Control System in detail.**
 - **Appeared in:** Summer 2024 (Q5c, 07 Marks), Winter 2023 (Q4c OR, 07 Marks), Winter 2024 (Q4c OR, 07 Marks).
 - **Weightage:** High.
 - **Notes:** A major 7-mark question. Cover point-to-point, continuous path control, and servo vs. non-servo systems.
4. **What do you mean by precision & accuracy in robotics? Explain with a sketch.**
 - **Appeared in:** Summer 2023 (Q5c OR, 07 Marks), Summer 2024 (Q5b, 04 Marks).
 - **Weightage:** Medium.
 - **Notes:** Use the classic bullseye target diagram to illustrate the difference.
5. **Explain various methods of robot programming.**
 - **Appeared in:** Winter 2024 (Q4c, 07 Marks).
 - **Weightage:** Medium (Important newer question).
 - **Notes:** Methods include Lead-through programming, Walk-through programming, Off-line programming.

Other Important Questions:

1. **State the different attributes of a robot.**
 - **Appeared in:** Summer 2025 (Q5a, 03 Marks).
 - **Notes:** Attributes include number of axes, work envelope, payload, precision, etc.
2. **Define: Transducers, Sensors, and Actuators. Differentiate between them.**
 - **Appeared in:** Winter 2022 (Q5a, 03 Marks), Winter 2023 (Q4a OR, 03 Marks), Winter 2024 (Q4a, 03 Marks), Summer 2025 (Q5b, 04 Marks).
 - **Notes:** Fundamental definitions. Transducer converts energy form, Sensor monitors, Actuator causes action.
3. **Explain the advantages, limitations, and applications of robots.**
 - **Appeared in:** Winter 2023 (Q4b, 04 Marks), Winter 2024 (Q4b OR, 04 Marks).

- **Notes:** A very common and straightforward question.
- 4. **Explain the function of robot components: Manipulator, End effector, Shoulder, Gripper, Wrist, Elbow, Frame.**
 - **Appeared in:** Summer 2025 (Q5c, 07 Marks).
 - **Notes:** This is about "Robot Anatomy." Describe each part's role in the robot's structure.
- 5. **Differentiate between online and offline programming of robots.**
 - **Appeared in:** Summer 2025 (Q4b, 04 Marks).
 - **Notes:** Online: Done on the robot itself. Offline: Done on a separate computer system. A modern and important topic.

Chapter 6: Automated Machinery (Transfer Lines, ASRS, AGV, CMM)

Repeated Questions:

1. **Describe functions, working, and limitations of an automated transfer machine/line.**
 - **Appeared in:** Summer 2024 (Q4c, 07 Marks), Winter 2022 (Q4c OR, 07 Marks), Winter 2023 (Q4c OR, 07 Marks).
 - **Weightage:** High.
 - **Notes:** A key topic. Explain its use for high-volume production of identical parts.
2. **Explain the role of CMM in computer-aided quality control. What are its elements?**
 - **Appeared in:** Summer 2022 (Q4c, 07 Marks), Summer 2024 (Q4a OR, 03 Marks), Summer 2025 (Q4a OR, 03 Marks), Winter 2024 (Q5b OR, 04 Marks).
 - **Weightage:** High.
 - **Notes:** CMM for precision measurement. Elements: Mechanical structure, probe, control computer, software.
3. **What is AGV? Explain its working principles/types/guidance control.**
 - **Appeared in:** Summer 2023 (Q4b, 04 Marks), Summer 2022 (Q3a, 03 Marks), Summer 2022 (Q4b OR, 04 Marks).
 - **Weightage:** Medium.
 - **Notes:** Focus on guidance methods: wire-guided, tape-guided, laser-targeted.
4. **Illustrate Auto-storage and Auto-retrieval system (ASRS).**
 - **Appeared in:** Winter 2022 (Q5b OR, 04 Marks), Winter 2023 (Q5b, 04 Marks).
 - **Weightage:** Medium.
 - **Notes:** Describe the system with components like storage racks, S/R machine, and control.

Other Important Questions:

1. **Write a short note on automated material handling system.**
 - **Appeared in:** Winter 2023 (Q5b OR, 04 Marks), Winter 2024 (Q5b, 04 Marks).
 - **Notes:** Broader topic covering AGVs, ASRS, conveyors.
2. **List out different types of material handling equipment.**
 - **Appeared in:** Summer 2022 (Q3b, 04 Marks), Summer 2024 (Q3a, 03 Marks).
 - **Notes:** Can include cranes, conveyors, AGVs, industrial trucks.
3. **Derive problems associated with material handling system. / Write down problems...**
 - **Appeared in:** Winter 2022 (Q3a OR, 03 Marks), Winter 2024 (Q3a, 03 Marks).
 - **Notes:** Issues like cost, system integration, flexibility, and maintenance.
4. **Describe material storage system.**
 - **Appeared in:** Summer 2024 (Q3a OR, 03 Marks), Winter 2023 (Q3b, 04 Marks).
 - **Notes:** Differentiate between bulk storage, rack systems, and automated ASRS.

Numerical Question Alert (From Summer 2025 Paper, Q4c OR)

This is a second crucial numerical problem on AGV system sizing.

- **Question (Summer 2025, Q4c OR):** ...evaluate the number of AGVs required... delivery of 75 pieces per hour... data: Vehicle speed=4.02 kmph, Traffic factor=0.8, Loaded travel distance=220 m, Empty travel distance=150 m, Pick-up time=0.0042 hrs, Drop-off time=0.0043 hrs.

Chapter 7: Modular Automation Design

Repeated Questions:

1. **What is modular automation?**
 - **Appeared in:** Summer 2024 (Q4a, 03 Marks), Winter 2023 (Q5a, 03 Marks), Winter 2024 (Q5a, 03 Marks).
 - **Weightage:** High.
 - **Notes:** Designing systems from standardized, interchangeable modules for flexibility.
2. **Write a short note on [Casting/Machine/Press] shop design in modular automation.**
 - **Appeared in:** Winter 2023 (Q5c OR, 07 Marks), Winter 2024 (Q5c, 07 Marks), Summer 2022 (Q5c, 07 Marks).
 - **Weightage:** High.
 - **Notes:** A common 7-mark case study question. Understand the key processes and how automation modules are applied in each shop.

Other Important Questions:

1. **What is modular automation design? Enlist components for casting shop design.**
 - **Appeared in:** Summer 2025 (Q5a OR, 03 Marks).
 - **Notes:** Directly links the concept to a specific application.
2. **Explain with example modular automation for a machine shop.**
 - **Appeared in:** Summer 2022 (Q5c, 07 Marks).
 - **Notes:** Modules could include CNC machines, robotic loaders, and conveyor systems.
3. **Explain different automated flow lines used for modular automation.**
 - **Appeared in:** Summer 2022 (Q5c OR, 07 Marks).
 - **Notes:** Discuss in-line, rotary, and pallet-type transfer lines.

Chapter 8: Automation Economy

Repeated Questions:

1. **Discuss the effects/scope/feasibility of automation on the economy for the Indian market/industries.**
 - **Appeared in:** Summer 2023 (Q5a, 03 Marks), Summer 2024 (Q5a, 03 Marks), Winter 2022 (Q5b, 04 Marks), Winter 2023 (Q5c, 07 Marks), Winter 2024 (Q5c OR, 07 Marks), Summer 2025 (Q5b, 04 Marks).
 - **Weightage:** Very High.
 - **Notes:** An extremely frequent question. Discuss impacts on productivity, employment, global competitiveness, and skill development in the Indian context.
2. **Explain Break Even Point Analysis for automation.**
 - **Appeared in:** Summer 2023 (Q5b OR, 04 Marks).
 - **Weightage:** Medium.
 - **Notes:** A numerical concept. Understand the formula and how to plot the graph comparing automated vs. manual costs.
3. **List merits and demerits of automation in production systems.**
 - **Appeared in:** Summer 2022 (Q5a OR, 03 Marks).
 - **Weightage:** Medium.
 - **Notes:** A straightforward list-based question.

Non-Repeated/Unit-Specific Questions from Chapter 8:

1. **Why does automation need in foundry shops? / State reasons for automation in press shop.**
 - **Appeared in:** Summer 2022 (Q5b, 04 Marks), Summer 2022 (Q5b OR, 04 Marks), Winter 2023 (Q5b, 04 Marks).
 - **Notes:** Application-specific justifications for automation (harsh environment, repetitive tasks, high volume).
