

GUJARAT TECHNOLOGICAL UNIVERSITY
BE-7 SEMESTER – OLD PAPER – S22 TO S26 – QUESTION BANK
Subject Name & Code: Automation in Manufacturing - 3171922

Chapter 1: Introduction to Automation

Repeated Questions:

1. Automation – Basics & Classification:

- Q. What is Automation? Explain its types/classification. (SUMMER 2023, 3 Marks; SUMMER 2024, 3+7 Marks; WINTER 2022, 3 Marks; WINTER 2023, 7 Marks; SUMMER 2022, 7 Marks OR)
- Q. List the reasons/feasibility for automation. (SUMMER 2024, 3+4 Marks; WINTER 2023, 4 Marks; SUMMER 2022, 3 Marks)
- Q. What are the levels of automation? (SUMMER 2022, 7 Marks OR; SUMMER 2026, 4 Marks)

2. Principles & Strategies:

- Q. Explain the USA Principle. (SUMMER 2023, 7 Marks; WINTER 2023, 3 Marks; SUMMER 2022, 4 Marks)
- Q. Explain Ten Strategies for Automation and Process Improvement. (SUMMER 2023, 7 Marks; SUMMER 2022, 7 Marks; SUMMER 2025, 7 Marks OR; WINTER 2025, 7 Marks; SUMMER 2026, 4 Marks)
- Q. Explain Automation Migration Strategies. (SUMMER 2025, 7 Marks; SUMMER 2026, 7 Marks)

3. Automated Manufacturing Systems:

- Q. Interpret Modular automations and its applications. (WINTER 2022, 4 Marks; WINTER 2025, 4 Marks)
- Q. Explain in detail Automated manufacturing system with a diagram. (WINTER 2022, 7 Marks; WINTER 2024, 7 Marks)

Other Important Questions:

1. Systems, Sensors & Flexibility:

- Q. Define automated manufacturing system. Enlist its various elements. (SUMMER 2025, 3 Marks)
- Q. Describe the various types of sensors used in automation. Suggest sensors used in smartphones. (SUMMER 2025, 4 Marks)
- Q. What is flexibility in manufacturing? Explain briefly with suitable example. (SUMMER 2026, 3 Marks)

Chapter 2: Group Technology and Cellular Manufacturing

Repeated Questions:

1. Group Technology:

- Q. Explain Group Technology with a suitable example. (SUMMER 2023, 3 Marks; SUMMER 2024, 4 Marks; WINTER 2022, 3 Marks; WINTER 2023, 3 Marks; WINTER 2024, 3 Marks; WINTER 2025, 3 Marks; SUMMER 2026, 3 Marks)
- Q. Explain cellular manufacturing system. (SUMMER 2024, 4 Marks; WINTER 2022, 4 Marks; WINTER 2023, 4 Marks)

2. Part Classification & Coding:

- Q. Explain the OPITZ/OPTZ parts classification and coding system. (SUMMER 2023, 7 Marks; SUMMER 2024, 7 Marks OR; WINTER 2023, 7 Marks; SUMMER 2022, 7 Marks; WINTER 2025, 7 Marks OR)
- Q. Explain types of part classification and coding systems. (SUMMER 2024, 7 Marks; SUMMER 2025, 7 Marks; WINTER 2025, 7 Marks)

3. Rank Order Clustering:

- Q. Describe the Rank Order Clustering (ROC) technique. (WINTER 2022, 7 Marks OR; WINTER 2023, 7 Marks OR; WINTER 2024, 7 Marks; SUMMER 2025, 3 Marks; SUMMER 2026, 4 Marks)

Other Important Questions:

1. Part Families & Cells:

- Q. What are part families? Explain methods of grouping parts. (SUMMER 2022, 3 Marks)
- Q. What is meant by “Key machine” in cellular manufacturing? Justify with a sketch. (SUMMER 2025, 4 Marks)
- Q. Define key machine and differentiate between group technology and cellular manufacturing. (WINTER 2025, 4 Marks)
- Q. Explain production flow analysis with a suitable example. (SUMMER 2026, 4 Marks)

2. Coding Structures & ROC:

- Q. Explain basic code structures used in parts classification. (SUMMER 2023, 7 Marks OR)
- Q. State the objective and applications of rank order clustering (ROC). (SUMMER 2025, 3 Marks)

Chapter 3: Flexible Manufacturing Systems (FMS)

Repeated Questions:

1. FMS – Components, Applications & Flexibility:

- **Q.** What is FMS? Explain its components/elements. (SUMMER 2023, 7 Marks; SUMMER 2024, 3 Marks; WINTER 2023, 3 Marks; SUMMER 2022, 7 Marks; SUMMER 2025, 3 Marks)
- **Q.** List applications and advantages of FMS. (WINTER 2022, 3 Marks; WINTER 2023, 3 Marks OR; SUMMER 2024, 7 Marks OR; WINTER 2024, 3 Marks OR; SUMMER 2026, 4 Marks OR)
- **Q.** Explain the types of flexibilities in FMS. (SUMMER 2023, 3 Marks; SUMMER 2023, 3 Marks OR; SUMMER 2025, 4 Marks; WINTER 2024, 4 Marks; WINTER 2025, 4 Marks)
- **Q.** Explain Automated Guided Vehicles (AGVs) / Automated Storage and Retrieval Systems (ASRS) associated with FMS. (WINTER 2023, 7 Marks; WINTER 2024, 7 Marks OR; SUMMER 2025, 3 Marks OR; WINTER 2025, 7 Marks OR)

2. FMS Layout & Economics:

- **Q.** Elaborate FMS with a diagram. (WINTER 2022, 4 Marks; WINTER 2024, 4 Marks)
- **Q.** Illustrate types of FMS and its components with a sketch. (WINTER 2022, 7 Marks; WINTER 2025, 7 Marks)
- **Q.** Write a short note on effect of automation on economics. (SUMMER 2024, 7 Marks; WINTER 2022, 7 Marks OR; WINTER 2025, 4 Marks)

Other Important Questions:

1. Fixed vs. Flexible Automation & Quantitative Analysis:

- **Q.** Differentiate between fixed and flexible automation. (SUMMER 2022, 7 Marks)
- **Q.** What is meant by quantitative analysis of FMS? Explain any one mathematical model. (SUMMER 2025, 7 Marks)

2. FMS (Numerical):

- **Q.** A flexible machining system consists of two machining workstations and a load/unload station. Station 1 is the load/unload station. Station 2 performs milling operations and consists of two servers (two identical CNC milling machines). Station 3 has one server that performs drilling (one CNC drill press). The stations are connected by a part handling system that has four work carriers. The mean transport time is 3.0 min. The FMS produces two parts, A and B. The part mix fractions and process routings for the two parts are presented in the table below. The operation frequency is 1 for all operations. Determine: (i) maximum production rate of the FMS, (ii) corresponding production rates of each product, (iii) utilization of each station, and (iv) number of busy servers at each station. [Table given – refer to the original question paper of S26] (SUMMER 2026, 7 Marks)

Chapter 4: Pneumatic and Hydraulic Systems

Repeated Questions:

1. Applications & Limitations:

- Q. Enlist/Explain applications of pneumatic and hydraulic systems in automation. (SUMMER 2023, 7 Marks; WINTER 2022, 3 Marks; WINTER 2023, 4 Marks OR; SUMMER 2024, 7 Marks OR; SUMMER 2025, 3 Marks; WINTER 2025, 3 Marks OR)
- Q. Enlist limitations of pneumatics and hydraulic systems. (SUMMER 2023, 3 Marks OR; SUMMER 2024, 4 Marks; SUMMER 2022, 4 Marks; SUMMER 2026, 4 Marks OR)

2. Components & Actuators:

- Q. Explain hydraulic/pneumatic system components. (WINTER 2022, 7 Marks; WINTER 2023, 7 Marks OR; SUMMER 2024, 4 Marks OR; WINTER 2025, 4 Marks OR)
- Q. Explain various types of actuators (including rotary). (WINTER 2023, 7 Marks OR; SUMMER 2025, 7 Marks OR; WINTER 2024, 7 Marks)

Other Important Questions:

1. Actuators & Components:

- Q. What is an actuator? Enlist different hydraulic actuators with functions. (SUMMER 2023, 3 Marks)
- Q. Illustrate Hydraulic actuators with a sketch. (WINTER 2022, 4 Marks)
- Q. Explain basic components used in a pneumatic automation system. (SUMMER 2022, 3 Marks OR)

2. Circuits:

- Q. Draw usual pneumatic circuit involving all basic elements. (SUMMER 2026, 3 Marks)
- Q. Explain working of hydraulic circuit for ram of a hydraulic shaper with the help of a neat sketch. (SUMMER 2026, 7 Marks)

Chapter 5: Industrial Robotics and Mechatronics

Repeated Questions:

1. Robot Configurations & Components:

- **Q.** List and explain different configurations of industrial robots. (SUMMER 2023, 3 Marks OR; SUMMER 2024, 3 Marks OR; SUMMER 2022, 3 Marks; WINTER 2025, 3 Marks OR)
- **Q.** Differentiate between End Effectors and Manipulators. (WINTER 2023, 3 Marks; WINTER 2024, 3 Marks OR; WINTER 2025, 3 Marks)
- **Q.** Explain the advantages, limitations, and applications of robots. (WINTER 2023, 4 Marks; WINTER 2024, 4 Marks OR; WINTER 2025, 4 Marks OR)

2. Control, Programming & Accuracy:

- **Q.** Explain Robot Control System in detail. (SUMMER 2024, 7 Marks; WINTER 2023, 7 Marks OR; WINTER 2024, 7 Marks OR; WINTER 2025, 7 Marks)
- **Q.** What do you mean by precision & accuracy in robotics? Explain with a sketch. (SUMMER 2023, 7 Marks OR; SUMMER 2024, 4 Marks)
- **Q.** Explain various methods of robot programming. (WINTER 2024, 7 Marks)

3. Sensors, Transducers & Actuators:

- **Q.** Define: Transducers, Sensors, and Actuators. Differentiate between them. (WINTER 2022, 3 Marks; WINTER 2023, 3 Marks OR; WINTER 2024, 3 Marks; SUMMER 2025, 4 Marks; WINTER 2025, 3 Marks OR; SUMMER 2026, 3 Marks OR)

Other Important Questions:

1. Robot Anatomy & Attributes:

- **Q.** State the different attributes of a robot. (SUMMER 2025, 3 Marks)
- **Q.** Explain the function of robot components: Manipulator, End effector, Shoulder, Gripper, Wrist, Elbow, Frame. (SUMMER 2025, 7 Marks)
- **Q.** Describe about industrial Robot in detail. (WINTER 2025, 7 Marks)
- **Q.** Explain 'end effectors' for robotics with suitable example. (SUMMER 2026, 3 Marks)

2. Programming & Sensors:

- **Q.** Differentiate between online and offline programming of robots. (SUMMER 2025, 4 Marks)
- **Q.** Briefly explain working of sensor in adaptive robotics. (SUMMER 2026, 4 Marks)
- **Q.** Write short note on 'selection criteria for sensors and actuators for robotics applications'. (SUMMER 2026, 7 Marks)

Chapter 6: Automated Material Handling, Transfer Machines, CMM, AGV, AS/RS

Repeated Questions:

1. Transfer Machines & CMM:

- Q. Describe functions, working, and limitations of an automated transfer machine/line. (SUMMER 2024, 7 Marks; WINTER 2022, 7 Marks OR; WINTER 2023, 7 Marks OR; WINTER 2025, 4 Marks; SUMMER 2026, 3 Marks)
- Q. Explain the role of CMM in computer-aided quality control. What are its elements? (SUMMER 2022, 7 Marks; SUMMER 2024, 3 Marks OR; SUMMER 2025, 3 Marks OR; WINTER 2024, 4 Marks OR; WINTER 2025, 7 Marks OR)

2. AGV & ASRS:

- Q. What is AGV? Explain its working principles/types/guidance control. (SUMMER 2023, 4 Marks; SUMMER 2022, 3 Marks; SUMMER 2022, 4 Marks OR; WINTER 2025, 3 Marks)
- Q. Illustrate Auto-storage and Auto-retrieval system (ASRS). (WINTER 2022, 4 Marks OR; WINTER 2023, 4 Marks; SUMMER 2026, 4 Marks)

3. Material Handling & Storage:

- Q. Write a short note on automated material handling system. (WINTER 2023, 4 Marks OR; WINTER 2024, 4 Marks)
- Q. List out different types of material handling equipment. (SUMMER 2022, 4 Marks; SUMMER 2024, 3 Marks)
- Q. Derive problems associated with material handling system. / Write down problems... (WINTER 2022, 3 Marks OR; WINTER 2024, 3 Marks)
- Q. Describe material storage system. (SUMMER 2024, 3 Marks OR; WINTER 2023, 4 Marks)

Other Important Questions:

1. AGV & CMM – Application:

- Q. Briefly explain the procedure of designing an AGV system with suitable example. (SUMMER 2026, 7 Marks OR)
- Q. Explain application of CMM for automated inspection with a suitable example. (SUMMER 2026, 7 Marks)

2. Transfer Machine & AGV (Numerical):

- Q. 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%. [Crucial numerical problem] (SUMMER 2025, 7 Marks)
- Q. ...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. [Crucial numerical problem on AGV system sizing] (SUMMER 2025, 7 Marks OR)

Chapter 7: Modular Automation Design

Repeated Questions:

1. Modular Automation:

- **Q.** What is modular automation? (SUMMER 2024, 3 Marks; WINTER 2023, 3 Marks; WINTER 2024, 3 Marks; WINTER 2025, 3 Marks; SUMMER 2026, 3 Marks OR)
- **Q.** Write a short note on [Casting/Machine/Press] shop design in modular automation. (WINTER 2023, 7 Marks OR; WINTER 2024, 7 Marks; SUMMER 2022, 7 Marks; SUMMER 2026, 7 Marks OR)

Other Important Questions:

1. Shop Design & Flow Lines:

- **Q.** What is modular automation design? Enlist components for casting shop design. (SUMMER 2025, 3 Marks OR)
- **Q.** Explain with example modular automation for a machine shop. (SUMMER 2022, 7 Marks)
- **Q.** Explain different automated flow lines used for modular automation. (SUMMER 2022, 7 Marks OR)

Chapter 8: Automation Economics, Feasibility, and Indian Context

Repeated Questions:

1. Economics of Automation:

- **Q.** Discuss the effects/scope/feasibility of automation on the economy for the Indian market/industries. (SUMMER 2023, 3 Marks; SUMMER 2024, 3 Marks; WINTER 2022, 4 Marks; WINTER 2023, 7 Marks; WINTER 2024, 7 Marks OR; SUMMER 2025, 4 Marks; WINTER 2025, 7 Marks OR)
- **Q.** Explain Break Even Point Analysis for automation. (SUMMER 2023, 4 Marks OR; SUMMER 2026, 7 Marks OR)
- **Q.** List merits and demerits of automation in production systems. (SUMMER 2022, 3 Marks OR; WINTER 2025, 3 Marks)

2. Automation in Foundry & Press Shops:

- **Q.** Why does automation need in foundry shops? / State reasons for automation in press shop. (SUMMER 2022, 4 Marks; SUMMER 2022, 4 Marks OR; WINTER 2023, 4 Marks; WINTER 2025, 4 Marks OR)

Other Important Questions:

1. Feasibility:

- **Q.** Briefly discuss feasibility of automation in economic sense. (SUMMER 2026, 4 Marks OR)
