

SAMPLE PAPERS
DIPLOMA FIFTH SEMESTER EXAMINATION 2025 (JUT)
INDUSTRIAL AUTOMATION
DIPLOMA WALLAH

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Full Marks: 7 marks 0 | Time: 3 Hours

Instructions:

- Question No. 1 is compulsory.
 - Answer any **FOUR** questions from the remaining (Q.2 to Q. 7 marks).
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SECTION A: MULTIPLE CHOICE QUESTIONS (Compulsory)

Q. 1. Choose the most appropriate answer for the following: (7 *2 = 14 Marks)

i. Which type of timer in PLC retains its accumulated time even after the input power is interrupted?

- a) On-Delay Timer (TON)
- b) Off-Delay Timer (TOF)
- c) Retentive On-Delay Timer (RTO)
- d) Pulse Timer

ii. The primary principle used by a Variable Frequency Drive (VFD) to maintain motor torque is:

- a) Keeping motor current constant.
- b) Keeping motor voltage constant.
- c) Keeping the V/f ratio constant.
- d) Keeping the slip frequency constant.

iii. Which component is the central communication and control hub in a SCADA system?

- a) Remote Terminal Unit (RTU)
- b) Programmable Logic Controller (PLC)
- c) Master Terminal Unit (MTU)
- d) Human Machine Interface (HMI)

iv. Which level represents the highest level of hierarchy in industrial automation?

- a) Field Level

- b) Control Level
- c) Supervisory Level
- d) Enterprise Level

v. A PLC instruction used to transfer data from one memory word to another is:

- a) EQU
- b) JMP
- c) MOV
- d) SUB

vi. Which industrial communication protocol is known for its simplicity and use in Master-Slave configurations?

- a) Foundation Fieldbus
- b) Ethernet/IP
- c) Profibus
- d) Modbus

vii. In a closed-loop control system, the corrective action is based on the:

- a) Setpoint value only.
- b) Measured variable value only.
- c) Error signal (difference between setpoint and measured value).
- d) Type of control valve used.

Q. 2.

A. Define Industrial Automation. Explain in detail the necessity and primary advantages (such as increased productivity, quality improvement, and safety) of automation in modern industries. [7 Marks]

B. Describe the building blocks and complete working principle of Variable Frequency Drives (VFDs)

. Explain the concept of V/f control. [7 Marks]

Q. 3.

A. Compare and contrast Open-Loop and Closed-Loop Control Systems. Explain the working principle of a closed-loop feedback system with a neat block

. [7 Marks]

B. Discuss the key criteria (Selection Criteria) that must be considered when selecting a suitable PLC for a specific industrial application. Briefly compare the different types and brands of PLCs available. [7 Marks]

Q. 4.

A. Explain the Five Critical Steps involved in PLC Program Development (e.g., Define Task, Define I/O, Develop Logical Sequence, etc.). [7 Marks]

B. Describe the structure, parameters, and functionality of various Timer Instructions used in PLCs. Specifically, explain the working of On-Delay Timer and Off-Delay Timer. [7 Marks]

Q. 5.

A. What is SCADA (Supervisory Control and Data Acquisition)? Explain its core objectives, primary functions, and key applications in real-time monitoring and control. [7 Marks]

B. Describe the necessary safety precautions that must be followed during the physical installation of a PLC system. Explain the system's power requirements, and the essential roles of safety circuitry like Emergency Stop (E-Stop). [7 Marks]

Q. 6.

A. Write a detailed note on the common causes of PLC failure and the classification of faults (Hardware vs. Software Faults). [7 Marks]

B. Explain the fundamentals of Servo Motors and their application in motion control systems. Differentiate between Servo Drives and general AC Drives based on their operation and application areas. [7 Marks]

Q. 7. Write short notes on any FOUR of the following: (4 *3.5 = 14)

A. Advantages of PLC over traditional relay logic.

B. Roles of Isolation Transformers and SMPS in a PLC setup.

C. What are the torque/current vs. frequency characteristics of VFDs?

D. What is the significance of the OSI model in industrial networking?

E. Give a brief introduction to the basic components used in pneumatic systems.

ANSWER KEY AND MODEL SOLUTIONS (Paper 1)**MCQ Answer Key (Q. 1)**

Q. No.	Answer	Q. No.	Answer	Q. No.	Answer	Q. No.	Answer
i.	(c)	ii.	(c)	iii.	(c)	iv.	(d)
v.	(c)	vi.	(d)	vii.	(c)		

Short Answer Solutions (Q. 7)

Part	Concept & Key Points
A	Advantages of PLC over Relay Logic: Faster operation (scan time in milliseconds), smaller physical size, easier modification/flexibility (software change vs. rewiring), higher reliability, and built-in diagnostic features.
B	Roles of Isolation Transformers and SMPS: Isolation Transformer separates the control circuit from the power line to prevent noise and surges. SMPS (Switched Mode Power Supply) converts AC to regulated, clean DC power (typically 24V DC) required by the PLC and I/O modules, efficiently handling voltage fluctuations.
C	Torque/Current vs. Frequency Characteristics of VFDs: VFDs maintain the V/f ratio constant up to the motor's base frequency (e.g., 50 Hz). This ensures that the magnetic flux density remains constant, which, in turn, maintains the motor's Constant Torque capability. Above base frequency, voltage is constant, so torque drops off.
D	Significance of the OSI Model: The Open Systems Interconnection (OSI) model provides a standardized, seven-layer framework (Physical, Data Link, Network, Transport, Session, Presentation, Application) for how different systems communicate. In industrial networking, it helps in understanding and troubleshooting protocols like Modbus TCP/IP (layers 3, 4, 7) or Profibus (layers 1, 2, 7).
E	Basic Components used in Pneumatic Systems: Compressor (generates pressure), Air Preparation Unit (Filter, Regulator, Lubricator), Directional Control Valves (3/2, 5/2 way valves, control air flow path), and Actuators (Single-acting or Double-acting Cylinders, convert pressure to motion).

Model Answers for Long Questions (Q. 2-Q. 6)

- **L9 (VFD Working Principle):** Describe Rectifier (AC to DC), DC Bus (smoothing), and Inverter (DC to Variable AC).

- **L2 (Open vs. Closed Loop): Open Loop:** Output is not measured, simple construction, less accurate, no disturbance correction (e.g., Traffic Light). **Closed Loop:** Output is measured (feedback), compared to setpoint (error signal), highly accurate, complex construction (e.g., Temperature Control System). **Required Diagram:** Closed Loop System Block Diagram.
 - **L5 (PLC Timer Instructions):** Explain TON (Input ON --->time elapses --->Output ON), TOF (Input OFF --->time elapses --->Output OFF). Describe parameters: Timer Address, Preset Time (PT), and Accumulated Time (ACC).
 - **L11 (SCADA System): Objectives:** Supervisory control, alarm logging, process visualization. **Functions:** Data Acquisition, Data Communication, Network Security, Data Presentation. **Applications:** Oil and Gas pipelines, Power Generation/Distribution, Water Treatment Plants.
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