

**SAMPLE PAPERS****DIPLOMA FIFTH SEMESTER EXAMINATION 2025 ( JUT)****INDUSTRIAL AUTOMATION****DIPLOMA WALLAH**[CLICK HERE TO VISIT DIPLOMA WALLAH WEBSITE](#)

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Full Marks: 7 marks o | 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.

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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.

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

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	<b>Advantages of PLC over Relay Logic:</b> Faster operation (scan time in milliseconds), smaller physical size, easier modification/flexibility (software change vs. rewiring), higher reliability, and built-in diagnostic features.
B	<b>Roles of Isolation Transformers and SMPS:</b> <b>Isolation Transformer</b> separates the control circuit from the power line to prevent noise and surges. <b>SMPS (Switched Mode Power Supply)</b> converts AC to regulated, clean DC power (typically 24V DC) required by the PLC and I/O modules, efficiently handling voltage fluctuations.
C	<b>Torque/Current vs. Frequency Characteristics of VFDs:</b> 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 <b>Constant Torque</b> capability. Above base frequency, voltage is constant, so torque drops off.
D	<b>Significance of the OSI Model:</b> 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	<b>Basic Components used in Pneumatic Systems:</b> <b>Compressor</b> (generates pressure), <b>Air Preparation Unit</b> (Filter, Regulator, Lubricator), <b>Directional Control Valves</b> (3/2, 5/2 way valves, control air flow path), and <b>Actuators</b> (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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