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).

SECTION A: MULTIPLE CHOICE QUESTIONS (Compulsory)

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

i. Which instruction type in a PLC is often used to ensure that the output remains ON after a momentary start button is released?

a) Comparison

b) Latching (S/R)

c) Math

d) Shift Register

ii. Which component in a SCADA system provides the graphical interface for the human operator?

a) RTU

b) MTU

c) HMI

d) PLC

iii. The main function of the Rectifier stage in a VFD is to convert:

a) AC to Variable AC

b) DC to AC

c) AC to DC

d) DC to Variable DC

iv. In a typical PLC installation, which device provides a clean, regulated 24V DC power supply?

a) Isolation Transformer

b) Circuit Breaker

c) SMPS (Switched Mode Power Supply)

d) Emergency Stop

v. Which level in the industrial automation hierarchy is responsible for executing the logic program and directly interfacing with the field level?

a) Supervisory Level

b) Control Level (PLC/Controller)

c) Enterprise Level

d) Management Level

vi. If a measured tank level (register D100) must be monitored to ensure it is above 50 (D200) before a pump can start, which instruction must be used?

a) EQU (Equal)

b) GRT (Greater Than)

c) LIM (Limit)

d) TOF (Off Delay Timer)

vii. Which is a characteristic feature of a Closed-Loop Control System?

a) Simplicity

b) Absence of feedback

c) High accuracy

d) Low maintenance complexity

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 diagram

. [7 Marks]

B. Describe the SCADA hardware components, focusing specifically on the functions, hardware, and software of Remote Terminal Units (RTUs). How do RTUs differ from PLCs? [7 Marks]

Q. 4.

A. What are the necessary safety precautions that must be followed during the physical installation of a PLC system? Explain the essential roles of safety circuitry like Emergency Stop (E-Stop) and Master Control Relay (MCR). [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 Retentive On-Delay Timer. [7 Marks]

Q. 5.

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

B. Describe the specifications and industry interfaces of Color Touch Screen HMI panels. Explain how security features (like user groups and authentication) are implemented in HMIs. [7 Marks]

Q. 6.

A. 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]

B. Explain the necessity of Industrial Networking. Describe the different types of networking architecture and topologies used in industrial automation systems . [7 Marks]

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

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

B. List the widely-used open software (e.g., Citect, Wonderware) used for SCADA applications.

C. List the common causes of PLC failure related to the environment.

D. Define the role of the Master Terminal Unit (MTU) in a SCADA system.

E. Explain the function of any two PLC Comparison Instructions.

ANSWER KEY AND MODEL SOLUTIONS (Paper 3)

MCQ Answer Key (Q. 1)

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

Short Answer Solutions (Q. 7)

Part	Concept & Key Points (3.5 Marks Each)
A	**Significance of the OSI Model:** The Open Systems Interconnection (OSI) model provides a standardized, seven-layer framework (Physical ---->Application) for communication. In industrial networking, it simplifies understanding protocol behavior (e.g., Profibus uses only layers 1, 2, and 7) and aids in logical troubleshooting.
B	**SCADA Open Software:** SCADA systems often use commercial off-the-shelf software packages known for their scalability and wide feature set. Examples include **Citect**, **Wonderware InTouch**, and **Rockwell FactoryTalk View**.
C	**Environmental Causes of PLC Failure:** Excessive heat (leading to component failure), high humidity (causing corrosion and short circuits), electrical noise/EMI (causing program corruption or false triggering), and vibration (loosening connections).
D	**Role of MTU:** The MTU is the central hub/server in the SCADA system, located in the control room. Its role is to interface with operators, manage the database, handle communication with RTUs, and process data for graphical display, alarming, and reporting.
E	**Comparison Instructions: EQU (Equal):** Output is true when Source A data equals Source B data. **GRT (Greater Than):** Output is true when Source A data is numerically greater than Source B data.

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

- **L7 (Safety and Installation): Safety Precautions:** Proper grounding, clear labeling, segregation of I/O wiring (high voltage separate from low voltage), secure mounting. **E-Stop/MCR:** They are hardwired to immediately remove power from control circuits and outputs for personnel safety.

- **L13 (HMI Security): Specifications:** Screen size, resolution, communication ports (Ethernet/Serial), IP rating. **Security:** User Groups define roles (Operator, Supervisor, Engineer). Authentication (Password login) is required to access configuration screens or execute critical commands (like modifying setpoints).
- **L14 (Networking Necessity/Topologies): Necessity:** Data exchange, remote diagnostics, centralized control, and coordinated operation. **Topologies:** Describe Bus (simple, cheap, single failure stops all), Ring (self-healing with redundancy), and Star (centralized hub, robust to single device failure). **Required Diagram:** Industrial Network Topologies.
- **L9 (VFD Working Principle):** Describe Rectifier (AC to DC), DC Bus (smoothing), and Inverter (DC to Variable AC). Explain that V/f control keeps the magnetic flux (\Phi \propto V/f) constant, which is essential for maintaining motor torque. **Required Diagram:** VFD Block Diagram.