



एचपीसीएल राजस्थान रिफाइनरी लिमिटेड
HPCL Rajasthan Refinery Limited

HPCL RAJASTHAN REFINERY LIMITED

Regd. Office : Tel Bhavan, Sahkar Marg, Lal Kothi Vistar Jyoti Nagar

CIN NO: U23201RJ2013GOI043865

SYLLABUS FOR COMPUTER BASED TEST 2023-24 **INSTRUMENTATION ENGINEERING POSITIONS**

1. Electrical and Electronics Measurement

- a. Electrical circuits
- b. Analog meters
- c. Resistance, inductance and capacitance measurement
- d. Digital Instruments
- e. Signal generators and analysers
- f. Energy and power measurement

2. Analog Electronics

- a. Transistor
- b. Operational Amplifiers
- c. Signal Generators and filters
- d. Power devices and applications
- e. Regulators
- f. Power converters

3. Digital Electronics

- a. Logic families
- b. Combinational circuits
- c. Sequential circuits
- d. Analysis of sequential circuits
- e. Programmable logic devices

4. Transducers, sensors, actuators and automation

- a. Measurement systems and temperature measurement
- b. Pressure and level measurement
- c. Flow measurement
- d. Displacement, velocity and speed measurement

- e. Force, torque, vibration and acceleration measurement
- f. Advances in sensor technology
- g. Basics of sensors
- h. Overview of discrete and continuous processes
- i. Overview of sensors and transducers
- j. Actuators
- k. Industrial automation

5. Automatic Control System and Feedback Control

- a. Introduction and classification of control systems
- b. Signal flow graph
- c. Time Response Analysis
- d. Stability Analysis
- e. Root locus
- f. Frequency response analysis
- g. Feedback in control systems
- h. Importance and classification of control systems
- i. Dynamics of electrical and mechanical systems
- j. Open loop and closed loop systems

6. Process Loop Components

- a. Introduction to transmitters
- b. Final control elements
- c. Pneumatic components and systems
- d. Hydraulic components and systems
- e. Auxiliary components
- f. Hazardous area classification and safety

7. Microprocessors and Microcontrollers

- a. Microprocessor and microcontroller architecture basics
- b. Programming basics
- c. On-chip peripherals
- d. External peripherals
- e. RISC microcontroller

8. Power Electronics and Drives

- a. Power devices
- b. Rectifiers and converters

- c. Inverter and cycloconverter
- d. Power supply and quality
- e. Machine drives
- f. Control methods for power converters

9. Industrial Automation, Programming Logic Controller (PLC) and its Applications

- a. Introduction to automation
- b. Instrumentation standard protocols
- c. Introduction to PLC
- d. Application of PLC
- e. Interfacing to PLC
- f. Distributed control system
- g. Relay logic
- h. Times, counters instruction
- i. Serial communication
- j. PLC interfacing to AC and DC drives
- k. Development of SCADA
- l. Maintenance and troubleshooting of PLC based industrial system
- m. Programming of PLC
- n. Advanced PLC function
- o. Open system interconnection (OSI) model

10. Analytical Instrumentation

- a. Chemical instrumental analysis, classification
- b. UV-Visible spectrophotometers
- c. Emission spectra, quantitative measurements, flame photometer
- d. Chromatographic methods
- e. Different types of gas analysers
- f. Chemical sensors

11. Instrumentation and System Design

- a. Concept of instrumentation design
- b. Need analysis with respect to systems deployed
- c. Noise sources, loops
- d. Shielding Effectiveness, absorption and reflection loss
- e. ESD, inductive charging human body model, ESD protection in equipment
- f. Electronic design guideline noise
- g. Enclosure design guidelines, system specifications and standards

- h. Printed circuit board design guideline
- i. Reliability
- j. Bath tub curve
- k. MTTF, MTTR, MTBF

12. Optimization and Optimal Control

- a. Optimization fundamentals
- b. Unconstrained optimization
- c. Constrained optimization
- d. Optimal control problems
- e. Dynamic optimization

13. Process Instrumentation and Control

- a. Introduction to process
- b. Control system
- c. Modelling of process
- d. System identification
- e. Multivariate and multi-loop control
- f. Control schemes for process applications

14. Industrial Automation and Control

- a. Introduction and evolution of automation
- b. Elements of process control loop
- c. Concepts of process variable, set point, controlled variable, manipulated variable and load variable
- d. Introduction to network
- e. Overall fieldbus trends
- f. Instrumentation network design
- g. HART network and Foundation Fieldbus network
- h. Modbus TCP/IP
- i. Introduction to distributed control system
- j. Integration of PLC, DCS, HMI and SCADA
- k. Integration with RTUs, fieldbus and data highway
- l. Introduction to knowledge based software
- m. Data analytics tools
- n. Historian sizing
- o. Features extraction
- p. Features selection correlation analysis
- q. Principle component analysis

- r. Entropy
- s. Data labelling
- t. Machine learning approaches: Parametric and non-parametric model

15. Programming Engineering and Management

- a. Objectives of project management
- b. Types, classification and life cycle of projects
- c. Organization structure
- d. Management functions
- e. Project planning
- f. Project scheduling
- g. Network scheduling techniques
- h. Types of estimates, pricing process
- i. ISA standards
- j. Preliminary Engineering Documents
- k. Front End Engineering and Design Documents
- l. Risk Management

16. Industrial Internet of Things (IIoT)

- a. Introduction to IIoT and manufacturing basics
- b. IoT architecture
- c. Basic elements of IIoT
- d. Components of IIoT
- e. IoT platforms and data security
- f. Data analytics and cloud services
- g. Industrial Internet
- h. Field devices (sensors/ actuators)
- i. Middleware industrial internet of things, platforms
- j. Data analytics and security
- k. Industry 4.0

17. Soft Computing, Artificial Intelligence and Machine Learning for Process Control

- a. Artificial Intelligence fundamentals
- b. Neural network
- c. Fuzzy logic
- d. Genetic algorithms
- e. Evolutionary computation
- f. Introduction to Machine Learning

- g. Classification of Machine Learning algorithms
- h. Regression and classification
- i. Supervised, unsupervised and semi-supervised learning, algorithms
- j. Gradient descent algorithm, cost function, activation functions, data pre processing and transformation techniques
- k. Applications of ML to process control
- l. Development of models
- m. Model validations
- n. Development of data based controls
- o. Data based controls and ML based controls for process control applications

NOTE: The syllabus/topics mentioned are indicative in nature. Candidates are expected to possess significant knowledge/proficiency pertaining to the relevant subjects and their qualifying degree