



HPCL RAJASTHAN REFINERY LIMITED

Joint Venture between Hindustan Petroleum Corporation Limited (HPCL)
and Government of Rajasthan.

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CIN No.U23201RJ2013GOI043865

Advt. No - HRRL/RECT/02/2025

Computer Based Test (CBT) for Assistant Engineer – Instrumentation: S/G E1

As per Advt. No - HRRL/RECT/02/2025 clause no. 7 (mentioned in page 51), the syllabus for Assistant Engineer – Instrumentation: S/G E1 is given as below.

Duration: 2 hours

Total Marks: 100

All questions of the Computer Based Test (CBT) will be objective and multiple-choice type. Total number of questions in the CBT are 100. Each correct answer carries 1 mark and there is no **negative** marking for wrong answers.

Syllabus

Part-1: General Aptitude (Graduate – Level)

(30 Marks)

1. Intellectual Potential Test:

- Distance
- Syllogism
- Logical Operations
- Similarities and dissimilarities
- Verbal Comprehension
- Perpetual Reasoning
- Working Memory
- Processing Speed
- Fluid reasoning

2. Logical Reasoning & Data interpretation

- Seating arrangements and puzzles
- Series – verbal and number
- Relationships
- Coding-decoding

- Verbal and numerical Analogy
- Binary Logic
- Games and Tournaments
- Arrangements
- Team Formations
- Order and Ranking
- Table, Data Caselets – Reasoning-Based DI, 3. Column Graphs, Bar Graphs, Line Charts, Pie Charts, Routes and Network

3. Quantitative Aptitude

The test of QA may cover Number systems including questions on simplification, decimals, fraction, LCM and HCF, square root, divisibility test, Ratio & proportion, Percentage, Average, Profit & loss, Discount, Simple and compound interest, Mensuration, Time & Work, Time and distance, Algebraic identities, Problems on Age, Tables & Graphs etc.

4. English Language

| Program | Education Level | Course | Subject | Topic | Sub Topic | Concept / Type |
|------------------|-----------------|----------------------------------|-------------------|-----------------|-----------------------|---------------------|
| General Aptitude | HSC | General Verbal Ability - English | Grammar - English | Question Tags | Negative question tag | Sentence Completion |
| General Aptitude | HSC | General Verbal Ability - English | Grammar - English | Question Tags | Positive question tag | Sentence Completion |
| General Aptitude | HSC | General Verbal Ability - English | Grammar - English | Parts of speech | Adjective | Sentence Completion |
| General Aptitude | HSC | General Verbal Ability - English | Grammar - English | Parts of speech | Adverb | Sentence Completion |
| General Aptitude | HSC | General Verbal Ability - English | Grammar - English | Parts of speech | Prepositions | Sentence Completion |
| General Aptitude | HSC | General Verbal Ability - English | Grammar - English | Parts of speech | Conjunctions | Sentence Completion |
| General | HSC | General | Grammar | Parts of | Verb | Sentence |

| | | | | | | |
|-------------------------|-----|----------------------------------|---------------------------------|-----------|------------------------------|---|
| Aptitude | | Verbal Ability - English | - English | speech | | Completion |
| General Aptitude | HSC | General Verbal Ability - English | Indirect Writing - English | Prose | Syntax and structure | Para Jumbles |
| General Aptitude | HSC | General Verbal Ability - English | Indirect Writing - English | Sentences | Word Usage and Understanding | One word substitution |
| General Aptitude | HSC | General Verbal Ability - English | Reading Comprehension - English | Passage | Appropriate Title | Identify the suitable title for the passage |
| General Aptitude | HSC | General Verbal Ability - English | Reading Comprehension - English | Passage | Central theme of the passage | Identify the central theme of the passage |
| General Aptitude | HSC | General Verbal Ability - English | Reading Comprehension - English | Passage | Facts | Identify the facts given in the passage |
| General Aptitude | HSC | General Verbal Ability - English | Reading Comprehension - English | Passage | Inferences drawn | Identify the inferences drawn from the passage |
| General Aptitude | HSC | General Verbal Ability - English | Reading Comprehension - English | Passage | Structure of the passage | Identify the structure of the passage |
| General Aptitude | HSC | General Verbal Ability - English | Reading Comprehension - English | Passage | Summary | Select the correct summary for the passage |
| General Aptitude | HSC | General Verbal Ability - English | Reading Comprehension - English | Passage | Text to World connection | The most appropriate connection to the real-life situations |
| General Aptitude | HSC | General Verbal Ability - English | Reading Comprehension - English | Passage | Tone of the passage | Identify the tone of the passage |

| | | | | | | |
|-------------------------|-----|----------------------------------|---------------------------------|--------------------|------------|---|
| General Aptitude | HSC | General Verbal Ability - English | Reading Comprehension - English | Passage | Vocabulary | Antonyms of the word |
| General Aptitude | HSC | General Verbal Ability - English | Reading Comprehension - English | Passage | Vocabulary | Correct usage of the word in other examples |
| General Aptitude | HSC | General Verbal Ability - English | Reading Comprehension - English | Passage | Vocabulary | Synonyms of the word |
| General Aptitude | HSC | General Verbal Ability - English | Reading Comprehension - English | Passage | Vocabulary | Word meaning |
| General Aptitude | HSC | General Verbal Ability - English | Vocabulary - English | Idioms and Phrases | Idioms | Word-segment substitution |
| General Aptitude | HSC | General Verbal Ability - English | Vocabulary - English | Idioms and Phrases | Proverbs | Word-segment substitution |
| General Aptitude | HSC | General Verbal Ability - English | Vocabulary - English | Semantics | Antonyms | Identification of antonym in a sentence |
| General Aptitude | HSC | General Verbal Ability - English | Vocabulary - English | Semantics | Synonyms | Word meaning in sentence |

Part 2: Technical/Professional Knowledge

(70 Marks)

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

- g. Instrumentation and System Design
- h. Concept of instrumentation design
- i. Need analysis with respect to systems deployed
- j. Noise sources, loops
- k. Shielding Effectiveness, absorption and reflection loss
- l. ESD, inductive charging human body model, ESD protection in equipment
- m. Electronic design guideline noise
- n. Enclosure design guidelines, system specifications and standards
- o. Printed circuit board design guideline
- p. Reliability
- q. Bath tub curve
- r. 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

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

- y. Data labelling
- z. 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)

- m. Introduction to IIoT and manufacturing basics
- n. IIoT architecture
- o. Basic elements of IIoT
- p. Components of IIoT
- q. IIoT platforms and data security
- r. Data analytics and cloud services
- s. Industrial Internet
- t. Field devices (sensors/ actuators)
- u. Middleware industrial internet of things, platforms
- v. Data analytics and security
- w. Industry 4.0
- x. Soft Computing, Artificial Intelligence and Machine Learning for Process Control
- y. Artificial Intelligence fundamentals
- z. Neural network
 - aa. Fuzzy logic
 - bb. Genetic algorithms
 - cc. Evolutionary computation
 - dd. Introduction to Machine Learning
 - ee. Classification of Machine Learning algorithms
 - ff. Regression and classification
 - gg. Supervised, unsupervised and semi-supervised learning, algorithms
 - hh. Gradient descent algorithm, cost function, activation functions, data preprocessing and transformation techniques
 - ii. Applications of ML to process control
 - jj. Development of models
 - kk. Model validations
 - ll. Development of data-based controls
 - mm. Data based controls and ML based controls for process control application.

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.