SYLLABUS FOR MANAGEMENT TRAINEE - ROBOTICS

PART I- GENERAL MANAGEMENT APTITUDE (Marks – 25)

1. **Mental Ability & Reasoning (Intelligence & Critical Reasoning)**
    - **Logical Reasoning:** Syllogisms, statement & conclusions, statement & arguments, course of action, decision making.
    - **Analytical Reasoning:** Puzzles, seating arrangements, complex arrangements, linear and circular arrangements.
    - **Verbal Reasoning:** Series completion (alphanumeric, number, symbol), analogies, classification (odd one out), coding-decoding, blood relations, direction sense test.
    - **Non-Verbal Reasoning:** Visual reasoning, paper folding/cutting, mirror images.
2. **English Language & Comprehension (Language Comprehension)**
    - **Reading Comprehension:** Understanding and interpreting passages.
    - **Grammar:** Rules for tenses, prepositions, articles, subject-verb agreement, active and passive voice, direct and indirect speech, spotting errors.
    - **Vocabulary:** Synonyms, antonyms, idioms & phrases, one-word substitutions, words often confused and misused.
    - **Verbal Ability:** Sentence correction, sentence completion/fill in the blanks, para jumbles/sentence rearrangement.
3. **Data Analysis & Interpretation (Data Analysis & Sufficiency)**
    - **Data Interpretation (DI):** Analysis of data from sources such as bar graphs, line graphs, pie charts and tables.
    - **Data Sufficiency** & **basic Statistics**
4. **Numerical Ability (Mathematical Skills/Quantitative Aptitude)**
    - **Arithmetic:**
        - Number systems, HCF and LCM.
        - Percentages, profit & loss, simple & compound interest.
        - Ratio & proportion, averages, problems on ages.
        - Time & work, time & distance, pipes & cisterns.
        - Mixtures and allegations, partnership.
    - **Algebra:** Basic algebra, linear equations, inequalities, logarithms, permutations and combinations (occasionally).
    - **Geometry & Mensuration:** Basic geometry (triangles, circles) and mensuration (area and volume).

- **Simplification:** Square roots, cube roots, surds & indices

DISCILIPINE – ROBOTICS (Marks – 60)

1. Feedback Control Fundamentals

- Open-loop and closed-loop control systems
- Control system components and block diagrams
- Stability analysis (concept of stability, steady-state error)
- Time response analysis (transient and steady-state response)
- Control Theory: PID controllers, state-space modeling, and control algorithms for path following and trajectory tracking.

2. Signal Conditioning

- Analog and digital signals
- Amplifiers, filters, and noise reduction
- Signal scaling and isolation
- Data acquisition systems (ADC, DAC basics)
- Sensor signal interfacing techniques

3. Neural Networks and Reinforcement Learning

- Artificial neural network (ANN) fundamentals
- Perceptron and multilayer networks
- Training methods and loss functions (basic concepts)
- Reinforcement learning fundamentals
- Applications of RL in robotic control and decision-making

4. Robot Kinematics and Dynamics

- Robot coordinate frames and transformations
- Forward and inverse kinematics
- Degrees of freedom (DOF) and workspace
- Velocity and acceleration analysis
- Basics of robot dynamics (forces and torques)

5. Robot Control *(Joint Space & Task Space, Trajectory Planning)*

- Joint space vs task (Cartesian) space control
- Position, velocity, and torque control
- Trajectory planning methods
- Motion interpolation techniques

- Basics of force and impedance control

6. Sensors and Actuators for Robots

- Position, velocity, force, and vision sensors
- Proximity and tactile sensors
- Electric, hydraulic, and pneumatic actuators
- Actuator selection criteria
- Sensor fusion basics

7. Industrial Automation and PLCs

- Automation system architecture
- PLC hardware components
- PLC programming basics (ladder logic, function blocks)
- Industrial communication protocols
- Safety systems and standards in automation

8. Mechatronics and Embedded Control Systems

- Fundamentals of mechatronics systems
- Microcontrollers and embedded processors
- Interfacing sensors and actuators
- Real-time control concepts
- Embedded system communication interfaces

9. Artificial Intelligence Fundamentals

- Overview of AI and intelligent systems
- Knowledge representation and reasoning
- Search and optimization techniques
- Planning and decision-making concepts
- AI applications in robotics

10. Machine Learning and Deep Learning for Robotics

- Supervised, unsupervised, and reinforcement learning
- Feature extraction and model training
- Machine Learning in Autonomy: Basics of CNNs for object recognition and reinforcement learning for adaptive navigation. basics of CNNs, RNNs
- Model evaluation and performance metrics
- Applications of ML/DL in perception and control

11. Autonomous Systems & Robotics

- Navigation & Guidance: Global Positioning Systems (GPS), Inertial Navigation Systems (INS), and Doppler Velocity Logs (DVL).
- Sensing & Perception: Surface: LiDAR, Radar, and Computer Vision for obstacle detection, Underwater: Acoustic sensors, Multibeam Sonar, and Side-scan Sonar etc.

12. Mission Planning & Communication

- Collision Avoidance (COLREGs): Programming autonomous adherence to "Rules of the Road" for maritime safety.
- Communication Links: Satellite communication (SATCOM), Radio Frequency (RF), and Underwater Acoustic Communications.
- Mission Frameworks: Use of robotic middleware like ROS (Robot Operating System) or MOOS-IvP.
- Swarm Robotics: Basics of cooperative control and multi-vessel coordination.

13. Ethics, Regulations & Project Management

- Regulatory Landscape: IMO (International Maritime Organization) guidelines for MASS (Maritime Autonomous Surface Ships).
- Ethics of Autonomy: Responsibility in autonomous decision-making and defense applications.
- Lifecycle Management: Fabrication processes, test plan development, and field troubleshooting.

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Disclaimer: The Above syllabus is broadly indicative but not exhaustive. Examination paper will be related to the qualification and relevant experience as per the post advertised