GATE Robotics and Automation (RA)

Sample Paper – 2

Duration: 180 Minutes **Maximum Marks: 100**

Instructions

- This paper is modelled on the **GATE Robotics and Automation (RA)** paper structure.
- Attempt **General Aptitude**, **Part A**, and either **Part B1 Electrical** or **Part B2 Mechanical**.
- General Aptitude carries **15 marks**, Part A carries **60 marks**, and the chosen optional section carries **25 marks**.
- Question types are **MCQ**, **MSQ**, and **NAT**. Questions carry either **1 mark** or **2 marks**.
- Negative marking applies only to wrong MCQs: **1/3 mark** for 1-mark MCQs and **2/3 mark** for 2-mark MCQs.
- There is **no negative marking** for MSQ or NAT questions. MSQ questions have **no partial marking**.

General Aptitude - Compulsory

GA1. **[MCQ, 1 mark]** Choose the word closest in meaning to 'autonomous'.

(A) Self-governing

(B) Dependent

(C) Manual

(D) Delayed

GA2. **[MCQ, 1 mark]** Complete the sentence: The inspection robot moved slowly because the floor was ____.

(A) sleep

(B) slippery

(C) slippingly

(D) slip

GA3. **[NAT, 1 mark]** The ratio of defective to good parts is 1:9. What percent of parts are defective? *Answer type: Numerical Answer Type (enter the value).*

GA4. **[MCQ, 1 mark]** If every calibrated sensor is tested and S1 is not tested, which conclusion is valid?

(A) S1 is calibrated

(B) All sensors are uncalibrated

(C) S1 is not calibrated

(D) Testing is impossible

GA5. **[NAT, 1 mark]** A robot moves 18 m in 6 s at constant speed. Speed in m/s is: *Answer type: Numerical Answer Type (enter the value).*

GA6. **[NAT, 2 marks]** Machine A makes 12 parts/hour and machine B makes 18 parts/hour. Together, how many parts are made in 5 hours? *Answer type: Numerical Answer Type (enter the value).*

GA7. **[MCQ, 2 marks]** A test error changes from 5 mm to 2 mm. The improvement is:

(A) 20 percent

(B) 40 percent

(C) 80 percent

(D) 60 percent

GA8. **[NAT, 2 marks]** Two fair coins are tossed. Probability of exactly one head is: *Answer type: Numerical Answer Type (enter the value).*

GA9. **[MCQ, 2 marks]** Which is the best metric for comparing two robot arms for precise assembly?

(A) Repeatability

(B) Paint finish only

(C) Cable colour

(D) Operator age

GA10. **[NAT, 2 marks]** The average of five numbers is 14. Four numbers are 10, 12, 15 and 18. Find the fifth number. *Answer type: Numerical Answer Type (enter the value).*

Part A - Common Robotics and Automation Section

A1. **[MCQ, 1 mark]** The eigenvalues of an upper triangular matrix are:

(A) Its diagonal entries

(B) Always zero

(C) Its row sums only

(D) Its determinant repeated

A2. **[NAT, 1 mark]** For scalar field f = x^2 + y^2, the x-component of grad f at (1, 2) is: *Answer type: Numerical Answer Type (enter the value).*

A3. **[NAT, 1 mark]** For vector field F = (x, y, z), divergence of F is: *Answer type: Numerical Answer Type (enter the value).*

A4. **[MCQ, 1 mark]** The Laplace transform of 1 is:

(A) s

(B) 1/s

(C) s^2

(D) 0

A5. **[NAT, 1 mark]** A Poisson random variable has mean 4. Its variance is: *Answer type: Numerical Answer Type (enter the value).*

A6. **[NAT, 1 mark]** Using Simpson's 1/3 rule over one panel needs how many equally spaced function values? *Answer type: Numerical Answer Type (enter the value).*

A7. **[MCQ, 1 mark]** Kirchhoff's voltage law is based on conservation of:

(A) Charge

(B) Mass only

(C) Energy

(D) Momentum only

A8. **[MCQ, 1 mark]** Norton's equivalent circuit consists of:

(A) Voltage source in series resistance

(B) Inductor only

(C) Capacitor only

(D) Current source in parallel resistance

A9. **[NAT, 1 mark]** In a pure inductor, current lags voltage by how many degrees? *Answer type: Numerical Answer Type (enter the value).*

A10. **[MCQ, 1 mark]** In a balanced three-phase load, total instantaneous power is:

(A) Constant

(B) Always zero

(C) Random

(D) Negative only

A11. **[MCQ, 1 mark]** An incremental encoder primarily provides:

(A) Only hydraulic force

(B) Relative position pulses

(C) pH value

(D) Temperature in kelvin only

A12. **[MCQ, 1 mark]** An LVDT is used to measure:

(A) Sound frequency only

(B) Fluid pH

(C) Linear displacement

(D) Chemical composition

A13. **[MCQ, 1 mark]** Piezoelectric sensors are well suited for measuring:

(A) PLC program length

(B) Static pressure forever without leakage

(C) Binary search trees

(D) Dynamic force or vibration

A14. **[MCQ, 1 mark]** A servo motor system usually includes feedback for:

(A) Closed-loop position or speed control

(B) Only uncontrolled spinning

(C) No command tracking

(D) Purely manual cutting

A15. **[MCQ, 1 mark]** Hydraulic actuators are commonly chosen for:

(A) Low force only

(B) High force density

(C) No fluid power

(D) Text processing

A16. **[MCQ, 1 mark]** A two-force member in equilibrium has forces that are:

(A) Only tensile always

(B) Random and unequal

(C) Equal, opposite and collinear

(D) At right angles

A17. **[NAT, 1 mark]** If coefficient of friction is 0.3 and wrap angle is 0, the belt tension ratio T1/T2 is: *Answer type: Numerical Answer Type (enter the value).*

A18. **[NAT, 1 mark]** In Python, len({'a':1, 'b':2, 'c':3}) returns: *Answer type: Numerical Answer Type (enter the value).*

A19. **[MCQ, 1 mark]** A queue follows which access rule?

(A) LIFO

(B) Heap-only

(C) Depth-only

(D) FIFO

A20. **[MCQ, 1 mark]** Breadth-first search uses which data structure most directly?

(A) Queue

(B) Stack only

(C) ADC

(D) Gear train

A21. **[MCQ, 2 marks]** A rotation matrix must satisfy:

(A) R ^ T R = 0

(B) R ^ T R = I

(C) det(R) = 0

(D) All entries must be 1

A22. **[MCQ, 2 marks]** In Denavit-Hartenberg convention, link twist is commonly denoted by:

(A) gamma only

(B) beta only

(C) alpha

(D) lambda only

A23. **[MCQ, 2 marks]** Inverse kinematics computes:

(A) Only sensor noise

(B) Only motor colour

(C) Only PLC scan time

(D) Joint variables for a desired end-effector pose

A24. **[MCQ, 2 marks]** A SCARA robot is especially common for:

(A) Planar assembly and pick-and-place

(B) Deep ocean drilling only

(C) Text mining only

(D) Chemical titration only

A25. **[MCQ, 2 marks]** Compared with serial manipulators, parallel manipulators often have:

(A) No joints

(B) High stiffness

(C) No singularities ever

(D) Only one link

A26. **[MSQ, 2 marks]** Which are common robot end-effectors?

(A) Vacuum gripper

(B) Welding torch

(C) Two-finger gripper

(D) Random access memory module

A27. **[MCQ, 2 marks]** Robot payload rating refers to:

(A) Only cable length

(B) Only controller weight

(C) Maximum load the robot can carry within specified conditions

(D) Only base paint

A28. **[MCQ, 2 marks]** Repeatability is the ability of a robot to:

(A) Compile code

(B) Always find true north

(C) Increase current

(D) Return to the same taught point repeatedly

A29. **[MCQ, 2 marks]** Continuous path control is most important for:

(A) Painting a smooth surface

(B) Only switching a lamp

(C) Static storage

(D) Reading one bit

A30. **[MCQ, 2 marks]** A PLC scan cycle typically includes:

(A) Only paint parts

(B) Read inputs, execute program, update outputs

(C) Only mesh analysis

(D) Only weld cooling

A31. **[MSQ, 2 marks]** Which are automated identification and capture technologies?

(A) Barcode

(B) RFID

(C) QR code

(D) Plain bearing

A32. **[MCQ, 2 marks]** An AGV in a factory is used mainly for:

(A) Calculus integration only

(B) Analog filtering only

(C) Automated material movement

(D) Ozone measurement only

A33. **[NAT, 2 marks]** A two-axis table has X and Y axes. How many linear positioning axes does it have? *Answer type: Numerical Answer Type (enter the value).*

A34. **[MCQ, 2 marks]** Concurrent engineering encourages:

(A) Manual-only storage

(B) Late manufacturing input only

(C) No communication

(D) Simultaneous design and manufacturing planning

A35. **[MCQ, 2 marks]** In a position servo, the feedback device is commonly a:

(A) Encoder

(B) Sand mould

(C) Bile duct

(D) Hardness indenter only

A36. **[NAT, 2 marks]** A wheel of radius 0.2 m rolls without slip at angular speed 5 rad/s. Linear speed in m/s is: *Answer type: Numerical Answer Type (enter the value).*

A37. **[NAT, 2 marks]** Two resistors 2 ohm and 3 ohm are in series with a 10 V source. Current in amperes is: *Answer type: Numerical Answer Type (enter the value).*

A38. **[MCQ, 2 marks]** In a series RLC circuit, resonance occurs when:

(A) Resistance is zero only

(B) Inductive and capacitive reactances are equal

(C) Voltage is always zero

(D) Current cannot flow

A39. **[NAT, 2 marks]** A rigid body pose in 3D has 3 position and how many orientation degrees of freedom? *Answer type: Numerical Answer Type (enter the value)*.

A40. **[MCQ, 2 marks]** An emergency stop circuit in automation should be:

(A) Optional decoration

(B) Hidden in source code only

(C) Hard-wired and fail-safe where required

(D) Used only for lighting

Part B1 - Electrical Engineering Optional

B11. **[MCQ, 1 mark]** A band-reject filter attenuates:

(A) A band of frequencies

(B) Only DC forever

(C) Only all low frequencies

(D) Only all high frequencies

B12. **[MCQ, 1 mark]** An inverting summing amplifier is commonly used to:

(A) Measure hardness

(B) Add weighted input voltages with inversion

(C) Store water

(D) Cut gears

B13. **[NAT, 1 mark]** A 10-bit ADC has how many levels? *Answer type: Numerical Answer Type (enter the value).*

B14. **[MCQ, 1 mark]** A DAC converts:

(A) Torque to strain only

(B) Analog voltage to binary only

(C) Digital code to analog signal

(D) Heat to CAD

B15. **[MCQ, 1 mark]** A 555 timer can be used as:

(A) Beam support

(B) Gear tooth

(C) Hydraulic seal

(D) Astable oscillator

B16. **[MCQ, 2 marks]** A microcontroller interrupt is used to:

(A) Temporarily suspend normal flow and service an event

(B) Increase beam stress

(C) Lower ADC bits

(D) Eliminate memory

B17. **[MCQ, 2 marks]** A sample-and-hold circuit is placed before an ADC mainly to:

(A) Increase gear ratio

(B) Keep input voltage nearly constant during conversion

(C) Remove all noise perfectly

(D) Store hydraulic fluid

B18. **[MCQ, 2 marks]** Convolution in time domain corresponds to which operation in frequency domain?

(A) Differentiation only

(B) Division only

(C) Multiplication

(D) No relation

B19. **[MCQ, 2 marks]** A causal system output at time t depends on:

(A) Only random noise

(B) Future inputs only

(C) No input ever

(D) Present and past inputs only

B110. **[MCQ, 2 marks]** The Z-transform is mainly used for analysis of:

(A) Discrete-time signals and systems

(B) Only static beams

(C) Only hydraulic fluids

(D) Only casting defects

B111. **[MCQ, 2 marks]** Root locus shows movement of closed-loop poles as:

(A) Paint dries

(B) Gain varies

(C) A shaft diameter is fixed

(D) A sensor is removed

B112. **[MCQ, 2 marks]** Nyquist stability criterion uses the frequency response of:

(A) Only gear mesh

(B) Only closed-loop step table

(C) Open-loop transfer function

(D) Only ADC count

B113. **[MCQ, 2 marks]** A lead compensator is generally used to improve:

(A) Only pH

(B) Only memory size

(C) Only beam weight

(D) Transient response and phase margin

B114. **[MCQ, 2 marks]** Integral action in a PI controller helps reduce:

(A) Steady-state error

(B) Link length

(C) ADC resolution

(D) Graph nodes

B115. **[MCQ, 2 marks]** A switched-mode power supply regulates voltage mainly using:

(A) Only series heating

(B) High-frequency switching

(C) Manual braking

(D) Belt friction

Part B2 - Mechanical Engineering Optional

B21. **[MCQ, 1 mark]** Mohr's circle is used for analysis of:

(A) PLC scan only

(B) Boolean algebra only

(C) ADC conversion only

(D) Plane stress and strain

B22. **[MCQ, 1 mark]** A load through the shear centre of a beam section causes:

(A) No stress ever

(B) Only twisting

(C) Bending without twisting

(D) Electrical resonance

B23. **[MCQ, 1 mark]** Thermal stress develops when thermal expansion is:

(A) Completely free

(B) Restrained

(C) Ignored by material

(D) Only in software

B24. **[MCQ, 1 mark]** A universal testing machine is commonly used for:

(A) Tension and compression tests

(B) Sampling theorem

(C) RFID reading

(D) PLC logic only

B25. **[MCQ, 1 mark]** Brinell and Rockwell tests measure:

(A) Queue length

(B) Velocity

(C) ADC levels

(D) Hardness

B26. **[MCQ, 2 marks]** Damping in a vibrating system generally:

(A) Removes mass

(B) Creates infinite energy

(C) Dissipates energy

(D) Eliminates stiffness

B27. **[MCQ, 2 marks]** Resonance in an SDOF system occurs when forcing frequency is close to:

(A) Zero always

(B) Natural frequency

(C) Sampling frequency only

(D) Gear tooth count

B28. **[MCQ, 2 marks]** A gyroscope resists changes in:

(A) Orientation of its spin axis

(B) Material hardness

(C) PLC address

(D) ADC bit count

B29. **[NAT, 2 marks]** For a shaft, critical speed is associated with resonance when rotational speed equals natural frequency. If natural frequency is 30 Hz, critical speed in rpm is: *Answer type: Numerical Answer Type (enter the value)*.

B210. **[MCQ, 2 marks]** Preloading a bolt helps improve joint performance by:

(A) Maintaining clamping force

(B) Removing threads

(C) Increasing backlash

(D) Changing ADC resolution

B211. **[MCQ, 2 marks]** A fillet weld is commonly used to join plates that are:

(A) Only floating in air

(B) Lap or tee connected

(C) Only digital

(D) Only lubricated

B212. **[NAT, 2 marks]** Two springs of stiffness 100 N/m and 200 N/m are connected in parallel. Equivalent stiffness in N/m is: *Answer type: Numerical Answer Type (enter the value)*.

B213. **[MCQ, 2 marks]** A clutch is used to:

(A) Store a graph

(B) Measure voltage

(C) Engage or disengage power transmission

(D) Perform Simpson integration

B214. **[MCQ, 2 marks]** CAD/CAM integration mainly helps by:

(A) Preventing any automation

(B) Eliminating all tolerances

(C) Removing all sensors

(D) Linking design data to manufacturing processes

B215. **[MCQ, 2 marks]** The factor of safety is defined as:

(A) Failure strength divided by allowable working stress or load measure

(B) ADC level divided by time

(C) Queue length divided by stack length

(D) Voltage divided by current only

Detailed Solutions

General Aptitude - Compulsory

GA1.

Solution

Concept — Verbal Aptitude: Identify the relevant concept, formula or rule and apply it to the given data.

Reasoning: Autonomous means capable of operating or governing itself.

Question Type: MCQ; **Marks:** 1.

Final Answer: The correct answer is $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to GA1

GA2.

Solution

Concept — Verbal Reasoning: Identify the relevant concept, formula or rule and apply it to the given data.

Reasoning: The adjective 'slippery' correctly describes the floor.

Question Type: MCQ; **Marks:** 1.

Final Answer: The correct answer is $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to GA2

GA3.

Solution

Concept — Ratios: Identify the relevant concept, formula or rule and apply it to the given data.

Reasoning: There is 1 defective part out of 10 total parts, so percentage = 10.

Question Type: NAT; **Marks:** 1.

Final Answer: The correct answer is $\Rightarrow$ $\boxed{10}$

Answer: (10) Go Back to GA3

GA4.

Solution

Concept — Logical Reasoning: Identify the relevant concept, formula or rule and apply it to the given data.

Reasoning: If calibrated implies tested, then not tested implies not calibrated by contrapositive.

Question Type: MCQ; **Marks:** 1.

Final Answer: The correct answer is $\Rightarrow$ C

Answer: (C) Go Back to GA4

GA5.

Solution

Concept — Arithmetic: Identify the relevant concept, formula or rule and apply it to the given data.

Reasoning: Speed = distance/time = 18/6 = 3 m/s.

Question Type: NAT; **Marks:** 1.

Final Answer: The correct answer is $\Rightarrow$ 3

Answer: (3) Go Back to GA5

GA6.

Solution

Concept — Work Rate: Identify the relevant concept, formula or rule and apply it to the given data.

Reasoning: Combined rate = 30 parts/hour. In 5 hours, output = 150 parts.

Question Type: NAT; **Marks:** 2.

Final Answer: The correct answer is $\Rightarrow$ 150

Answer: (150) Go Back to GA6

GA7.

Solution

Concept — Data Interpretation: Identify the relevant concept, formula or rule and apply it to the given data.

Reasoning: Reduction = 3 mm out of 5 mm, so improvement = 60 percent.

Question Type: MCQ; **Marks:** 2.

Final Answer: The correct answer is $\Rightarrow$ D

Answer: (D) Go Back to GA7

GA8.

Solution

Concept — Probability: Identify the relevant concept, formula or rule and apply it to the given data.

Reasoning: Outcomes HT and TH satisfy the event, so probability = 2/4 = 0.5.

Question Type: NAT; **Marks:** 2.

Final Answer: The correct answer is $\Rightarrow$ 0.5

Answer: (0.5) Go Back to GA8

GA9.

Solution

Concept — Critical Reasoning: Identify the relevant concept, formula or rule and apply it to the given data.

Reasoning: Repeatability is directly tied to precision in repeated positioning.

Question Type: MCQ; **Marks:** 2.

Final Answer: The correct answer is $\Rightarrow$ A

Answer: (A) Go Back to GA9

GA10.

Solution

Concept — Averages: Identify the relevant concept, formula or rule and apply it to the given data.

Reasoning: Total = 5 x 14 = 70. Known total = 55. Fifth number = 15.

Question Type: NAT; **Marks:** 2.

Final Answer: The correct answer is ⇒ 15

Answer: (15) Go Back to GA10

Part A - Common Robotics and Automation Section

A1.

Solution

Concept — Linear Algebra: Identify the relevant concept, formula or rule and apply it to the given data.

Reasoning: For a triangular matrix, eigenvalues are the diagonal elements.

Question Type: MCQ; **Marks:** 1.

Final Answer: The correct answer is ⇒ A

Answer: (A) Go Back to A1

A2.

Solution

Concept — Vector Calculus: Identify the relevant concept, formula or rule and apply it to the given data.

Reasoning: grad f = (2x, 2y). At x = 1, the x-component is 2.

Question Type: NAT; **Marks:** 1.

Final Answer: The correct answer is ⇒ 2

Answer: (2) Go Back to A2

A3.

Solution

Concept — Vector Calculus: Identify the relevant concept, formula or rule and apply it to the given data.

Reasoning: Divergence = d(x)/dx + d(y)/dy + d(z)/dz = 1 + 1 + 1 = 3.

Question Type: NAT; **Marks:** 1.

Final Answer: The correct answer is ⇒ 3

Answer: (3) Go Back to A3

A4.

Solution

Concept — Differential Equations: Identify the relevant concept, formula or rule and apply it to the given data.

Reasoning: L{1} = 1/s for Re(s) > 0.

Question Type: MCQ; **Marks:** 1.

Final Answer: The correct answer is ⇒ B

Answer: (B) Go Back to A4

A5.

Solution

Concept — Statistics: Identify the relevant concept, formula or rule and apply it to the given data.

Reasoning: For a Poisson distribution, mean and variance are both lambda.

Question Type: NAT; **Marks:** 1.

Final Answer: The correct answer is ⇒ 4

Answer: (4) Go Back to A5

A6.

Solution

Concept — Numerical Methods: Identify the relevant concept, formula or rule and apply it to the given data.

Reasoning: One Simpson 1/3 panel uses values at the two ends and midpoint, so three values.

Question Type: NAT; **Marks:** 1.

Final Answer: The correct answer is ⇒ 3

Answer: (3) Go Back to A6

A7.

Solution

Concept — Networks: Identify the relevant concept, formula or rule and apply it to the given data.

Reasoning: KVL follows from conservation of energy around a closed loop.

Question Type: MCQ; **Marks:** 1.

Final Answer: The correct answer is ⇒ C

Answer: (C) Go Back to A7

A8.

Solution

Concept — Network Theorems: Identify the relevant concept, formula or rule and apply it to the given data.

Reasoning: A Norton equivalent is a current source in parallel with equivalent resistance.

Question Type: MCQ; **Marks:** 1.

Final Answer: The correct answer is ⇒ D

Answer: (D) Go Back to A8

A9.

Solution

Concept — AC Circuits: Identify the relevant concept, formula or rule and apply it to the given data.

Reasoning: For an ideal inductor, current lags voltage by 90 degrees.

Question Type: NAT; **Marks:** 1.

Final Answer: The correct answer is $\Rightarrow$ $\boxed{90}$

Answer: (90) Go Back to A9

A10.

Solution

Concept — Three-Phase Circuits: Identify the relevant concept, formula or rule and apply it to the given data.

Reasoning: For a balanced three-phase system, total instantaneous power is constant.

Question Type: MCQ; **Marks:** 1.

Final Answer: The correct answer is $\Rightarrow$ $\boxed{A}$

Answer: (A) Go Back to A10

A11.

Solution

Concept — Encoders: Identify the relevant concept, formula or rule and apply it to the given data.

Reasoning: Incremental encoders generate pulses corresponding to relative motion.

Question Type: MCQ; **Marks:** 1.

Final Answer: The correct answer is $\Rightarrow$ $\boxed{B}$

Answer: (B) Go Back to A11

A12.

Solution

Concept — Sensors: Identify the relevant concept, formula or rule and apply it to the given data.

Reasoning: A linear variable differential transformer measures linear displacement.

Question Type: MCQ; **Marks:** 1.

Final Answer: The correct answer is $\Rightarrow$ C

Answer: (C) Go Back to A12

A13.

Solution

Concept — Piezoelectric Sensors: Identify the relevant concept, formula or rule and apply it to the given data.

Reasoning: Piezoelectric elements generate charge under changing mechanical stress and are common in dynamic measurements.

Question Type: MCQ; **Marks:** 1.

Final Answer: The correct answer is $\Rightarrow$ D

Answer: (D) Go Back to A13

A14.

Solution

Concept — Servo Motors: Identify the relevant concept, formula or rule and apply it to the given data.

Reasoning: Servo drives use feedback to track commanded position, speed or torque.

Question Type: MCQ; **Marks:** 1.

Final Answer: The correct answer is $\Rightarrow$ A

Answer: (A) Go Back to A14

A15.

Solution

Concept — Hydraulics: Identify the relevant concept, formula or rule and apply it to the given data.

Reasoning: Liquids can transmit high pressures, making hydraulic actuators suitable for high-force applications.

Question Type: MCQ; **Marks:** 1.

Final Answer: The correct answer is ⇒ B

Answer: (B) Go Back to A15

A16.

Solution

Concept — Engineering Mechanics: Identify the relevant concept, formula or rule and apply it to the given data.

Reasoning: For a body acted on by only two forces to be in equilibrium, they must be equal, opposite and collinear.

Question Type: MCQ; **Marks:** 1.

Final Answer: The correct answer is ⇒ C

Answer: (C) Go Back to A16

A17.

Solution

Concept — Belt Friction: Identify the relevant concept, formula or rule and apply it to the given data.

Reasoning: Belt friction relation is T1/T2 = e ^ (mu theta). If theta = 0, ratio = 1.

Question Type: NAT; **Marks:** 1.

Final Answer: The correct answer is ⇒ 1

Answer: (1) Go Back to A17

A18.

Solution

Concept — Python: Identify the relevant concept, formula or rule and apply it to the given data.

Reasoning: The dictionary has three keys.

Question Type: NAT; **Marks:** 1.

Final Answer: The correct answer is $\Rightarrow$ $\boxed{3}$

Answer: (3) Go Back to A18

A19.

Solution

Concept — Data Structures: Identify the relevant concept, formula or rule and apply it to the given data.

Reasoning: A queue is first-in-first-out.

Question Type: MCQ; **Marks:** 1.

Final Answer: The correct answer is $\Rightarrow$ $\boxed{D}$

Answer: (D) Go Back to A19

A20.

Solution

Concept — Graphs: Identify the relevant concept, formula or rule and apply it to the given data.

Reasoning: BFS explores level by level using a queue.

Question Type: MCQ; **Marks:** 1.

Final Answer: The correct answer is $\Rightarrow$ $\boxed{A}$

Answer: (A) Go Back to A20

A21.

Solution

Concept — Rotations: Identify the relevant concept, formula or rule and apply it to the given data.

Reasoning: A proper rotation matrix is orthonormal, so R^T R = I, with determinant +1.

Question Type: MCQ; **Marks:** 2.

Final Answer: The correct answer is ⇒ B

Answer: (B) Go Back to A21

A22.

Solution

Concept — DH Parameters: Identify the relevant concept, formula or rule and apply it to the given data.

Reasoning: The standard DH parameters are a, alpha, d and theta; alpha is link twist.

Question Type: MCQ; **Marks:** 2.

Final Answer: The correct answer is ⇒ C

Answer: (C) Go Back to A22

A23.

Solution

Concept — Inverse Kinematics: Identify the relevant concept, formula or rule and apply it to the given data.

Reasoning: Inverse kinematics solves for joint coordinates that produce a desired tool pose.

Question Type: MCQ; **Marks:** 2.

Final Answer: The correct answer is ⇒ D

Answer: (D) Go Back to A23

A24.

Solution

Concept — Manipulator Classification: Identify the relevant concept, formula or rule and apply it to the given data.

Reasoning: SCARA robots are widely used in planar assembly, insertion and pick-and-place tasks.

Question Type: MCQ; **Marks:** 2.

Final Answer: The correct answer is $\Rightarrow$ A

Answer: (A) Go Back to A24

A25.

Solution

Concept — Parallel Robots: Identify the relevant concept, formula or rule and apply it to the given data.

Reasoning: Parallel load paths generally improve stiffness, though singularities can still occur.

Question Type: MCQ; **Marks:** 2.

Final Answer: The correct answer is $\Rightarrow$ B

Answer: (B) Go Back to A25

A26.

Solution

Concept — End Effectors: Identify the relevant concept, formula or rule and apply it to the given data.

Reasoning: Vacuum, welding and finger grippers are common tool/end-effector choices.

Question Type: MSQ; **Marks:** 2.

Final Answer: The correct answer is $\Rightarrow$ ABC

Answer: (ABC) Go Back to A26

A27.

Solution

Concept — Payload: Identify the relevant concept, formula or rule and apply it to the given data.

Reasoning: Payload is the allowable carried load at the tool or wrist under rated performance conditions.

Question Type: MCQ; **Marks:** 2.

Final Answer: The correct answer is $\Rightarrow$ C

Answer: (C) Go Back to A27

A28.

Solution

Concept — Repeatability: Identify the relevant concept, formula or rule and apply it to the given data.

Reasoning: Repeatability measures the closeness of repeated attempts to reach the same commanded position.

Question Type: MCQ; **Marks:** 2.

Final Answer: The correct answer is $\Rightarrow$ D

Answer: (D) Go Back to A28

A29.

Solution

Concept — Continuous Path: Identify the relevant concept, formula or rule and apply it to the given data.

Reasoning: Painting requires smooth tool motion along a path.

Question Type: MCQ; **Marks:** 2.

Final Answer: The correct answer is $\Rightarrow$ A

Answer: (A) Go Back to A29

A30.

Solution

Concept — PLC Scan Cycle: Identify the relevant concept, formula or rule and apply it to the given data.

Reasoning: A PLC repeatedly samples inputs, solves logic and writes outputs.

Question Type: MCQ; **Marks:** 2.

Final Answer: The correct answer is $\Rightarrow$ B

Answer: (B) Go Back to A30

A31.

Solution

Concept — Automated Identification: Identify the relevant concept, formula or rule and apply it to the given data.

Reasoning: Barcode, RFID and QR codes can be used for identification and data capture.

Question Type: MSQ; **Marks:** 2.

Final Answer: The correct answer is $\Rightarrow$ ABC

Answer: (ABC) Go Back to A31

A32.

Solution

Concept — Material Handling: Identify the relevant concept, formula or rule and apply it to the given data.

Reasoning: Automated guided vehicles move materials through a facility.

Question Type: MCQ; **Marks:** 2.

Final Answer: The correct answer is $\Rightarrow$ C

Answer: (C) Go Back to A32

A33.

Solution

Concept — CNC Positioning: Identify the relevant concept, formula or rule and apply it to the given data.

Reasoning: The X and Y axes are two independent linear positioning axes.

Question Type: NAT; **Marks:** 2.

Final Answer: The correct answer is $\Rightarrow$ $\boxed{2}$

Answer: (2) Go Back to A33

A34.

Solution

Concept — Concurrent Design: Identify the relevant concept, formula or rule and apply it to the given data.

Reasoning: Concurrent design integrates product design, process planning and manufacturing considerations early.

Question Type: MCQ; **Marks:** 2.

Final Answer: The correct answer is $\Rightarrow$ $\boxed{D}$

Answer: (D) Go Back to A34

A35.

Solution

Concept — Motion Control: Identify the relevant concept, formula or rule and apply it to the given data.

Reasoning: Encoders are common position feedback devices in servo systems.

Question Type: MCQ; **Marks:** 2.

Final Answer: The correct answer is $\Rightarrow$ $\boxed{A}$

Answer: (A) Go Back to A35

A36.

Solution

Concept — Kinematics: Identify the relevant concept, formula or rule and apply it to the given data.

Reasoning: v = omega r = 5 x 0.2 = 1 m/s.

Question Type: NAT; **Marks:** 2.

Final Answer: The correct answer is ⇒ $\boxed{1}$

Answer: (1) Go Back to A36

A37.

Solution

Concept — Mesh Analysis: Identify the relevant concept, formula or rule and apply it to the given data.

Reasoning: Total resistance = 5 ohm. Current = 10/5 = 2 A.

Question Type: NAT; **Marks:** 2.

Final Answer: The correct answer is ⇒ $\boxed{2}$

Answer: (2) Go Back to A37

A38.

Solution

Concept — Resonance: Identify the relevant concept, formula or rule and apply it to the given data.

Reasoning: At resonance, XL = XC and net reactance is zero.

Question Type: MCQ; **Marks:** 2.

Final Answer: The correct answer is ⇒ $\boxed{B}$

Answer: (B) Go Back to A38

A39.

Solution

Concept — Robot Frames: Identify the relevant concept, formula or rule and apply it to the given data.

Reasoning: A 3D rigid body has three translational and three rotational degrees of freedom.

Question Type: NAT; **Marks:** 2.

Final Answer: The correct answer is $\Rightarrow \boxed{3}$

Answer: (3) Go Back to A39

A40.

Solution

Concept — Automation Safety: Identify the relevant concept, formula or rule and apply it to the given data.

Reasoning: Safety circuits are designed to bring equipment to a safe state reliably and often use hard-wired fail-safe logic.

Question Type: MCQ; **Marks:** 2.

Final Answer: The correct answer is $\Rightarrow \boxed{C}$

Answer: (C) Go Back to A40

Part B1 - Electrical Engineering Optional

B11.

Solution

Concept — Analog Filters: Identify the relevant concept, formula or rule and apply it to the given data.

Reasoning: A band-reject or notch filter suppresses frequencies in a selected band.

Question Type: MCQ; **Marks:** 1.

Final Answer: The correct answer is $\Rightarrow \boxed{A}$

Answer: (A) Go Back to B11

B12.

Solution

Concept — Op-Amp Applications: Identify the relevant concept, formula or rule and apply it to the given data.

Reasoning: The op-amp summing circuit produces the negative weighted sum of input voltages.

Question Type: MCQ; **Marks:** 1.

Final Answer: The correct answer is $\Rightarrow$ B

Answer: (B) Go Back to B12

B13.

Solution

Concept — ADC Resolution: Identify the relevant concept, formula or rule and apply it to the given data.

Reasoning: Number of quantization levels = 2^10 = 1024.

Question Type: NAT; **Marks:** 1.

Final Answer: The correct answer is $\Rightarrow$ 1024

Answer: (1024) Go Back to B13

B14.

Solution

Concept — DAC: Identify the relevant concept, formula or rule and apply it to the given data.

Reasoning: A digital-to-analog converter produces an analog output corresponding to a digital input code.

Question Type: MCQ; **Marks:** 1.

Final Answer: The correct answer is $\Rightarrow$ C

Answer: (C) Go Back to B14

B15.

Solution

Concept — Timers: Identify the relevant concept, formula or rule and apply it to the given data.

Reasoning: A 555 timer can operate in astable mode to generate pulses.

Question Type: MCQ; **Marks:** 1.

Final Answer: The correct answer is $\Rightarrow$ D

Answer: (D) Go Back to B15

B16.

Solution

Concept — Interrupts: Identify the relevant concept, formula or rule and apply it to the given data.

Reasoning: An interrupt redirects execution to a service routine when an event needs attention.

Question Type: MCQ; **Marks:** 2.

Final Answer: The correct answer is $\Rightarrow$ A

Answer: (A) Go Back to B16

B17.

Solution

Concept — Sample and Hold: Identify the relevant concept, formula or rule and apply it to the given data.

Reasoning: ADC conversion needs a stable input, so sample-and-hold circuits hold the sampled value.

Question Type: MCQ; **Marks:** 2.

Final Answer: The correct answer is $\Rightarrow$ B

Answer: (B) Go Back to B17

B18.

Solution

Concept — Signals: Identify the relevant concept, formula or rule and apply it to the given data.

Reasoning: Fourier transform of convolution is multiplication of transforms.

Question Type: MCQ; **Marks:** 2.

Final Answer: The correct answer is $\Rightarrow$ C

Answer: (C) Go Back to B18

B19.

Solution

Concept — Systems: Identify the relevant concept, formula or rule and apply it to the given data.

Reasoning: Causality requires that output not depend on future input values.

Question Type: MCQ; **Marks:** 2.

Final Answer: The correct answer is $\Rightarrow$ D

Answer: (D) Go Back to B19

B110.

Solution

Concept — Z Transform: Identify the relevant concept, formula or rule and apply it to the given data.

Reasoning: Z-transform is the standard transform tool for discrete-time systems.

Question Type: MCQ; **Marks:** 2.

Final Answer: The correct answer is $\Rightarrow$ A

Answer: (A) Go Back to B110

B111.

Solution

Concept — Root Locus: Identify the relevant concept, formula or rule and apply it to the given data.

Reasoning: Root locus plots closed-loop pole locations as a system parameter, usually gain, varies.

Question Type: MCQ; **Marks:** 2.

Final Answer: The correct answer is $\Rightarrow$ B

Answer: (B) Go Back to B111

B112.

Solution

Concept — Nyquist Criterion: Identify the relevant concept, formula or rule and apply it to the given data.

Reasoning: Nyquist analysis examines encirclements made by the open-loop frequency response.

Question Type: MCQ; **Marks:** 2.

Final Answer: The correct answer is $\Rightarrow$ C

Answer: (C) Go Back to B112

B113.

Solution

Concept — Lead Compensator: Identify the relevant concept, formula or rule and apply it to the given data.

Reasoning: Lead compensation adds phase lead and can improve speed and stability margins.

Question Type: MCQ; **Marks:** 2.

Final Answer: The correct answer is $\Rightarrow$ D

Answer: (D) Go Back to B113

B114.

Solution

Concept — PI Control: Identify the relevant concept, formula or rule and apply it to the given data.

Reasoning: Integral action accumulates error and can eliminate steady-state error for many inputs.

Question Type: MCQ; **Marks:** 2.

Final Answer: The correct answer is $\Rightarrow$ A

Answer: (A) Go Back to B114

B115.

Solution

Concept — SMPS: Identify the relevant concept, formula or rule and apply it to the given data.

Reasoning: SMPS circuits control output by rapidly switching semiconductor devices and filtering.

Question Type: MCQ; **Marks:** 2.

Final Answer: The correct answer is $\Rightarrow$ B

Answer: (B) Go Back to B115

Part B2 - Mechanical Engineering Optional

B21.

Solution

Concept — Mohr Circle: Identify the relevant concept, formula or rule and apply it to the given data.

Reasoning: Mohr's circle graphically represents stress or strain transformation.

Question Type: MCQ; **Marks:** 1.

Final Answer: The correct answer is $\Rightarrow$ D

Answer: (D) Go Back to B21

B22.

Solution

Concept — Shear Centre: Identify the relevant concept, formula or rule and apply it to the given data.

Reasoning: Loading through the shear centre avoids torsional twisting of the section.

Question Type: MCQ; **Marks:** 1.

Final Answer: The correct answer is $\Rightarrow$ C

Answer: (C) Go Back to B22

B23.

Solution

Concept — Thermal Stress: Identify the relevant concept, formula or rule and apply it to the given data.

Reasoning: If a member cannot expand or contract freely, temperature change produces thermal stress.

Question Type: MCQ; **Marks:** 1.

Final Answer: The correct answer is $\Rightarrow$ B

Answer: (B) Go Back to B23

B24.

Solution

Concept — Testing: Identify the relevant concept, formula or rule and apply it to the given data.

Reasoning: UTMs apply controlled tensile or compressive loads to test material properties.

Question Type: MCQ; **Marks:** 1.

Final Answer: The correct answer is $\Rightarrow$ A

Answer: (A) Go Back to B24

B25.

Solution

Concept — Hardness: Identify the relevant concept, formula or rule and apply it to the given data.

Reasoning: Brinell and Rockwell are standard hardness tests.

Question Type: MCQ; **Marks:** 1.

Final Answer: The correct answer is $\Rightarrow$ D

Answer: (D) Go Back to B25

B26.

Solution

Concept — Vibrations: Identify the relevant concept, formula or rule and apply it to the given data.

Reasoning: Damping dissipates mechanical energy and reduces oscillation amplitude.

Question Type: MCQ; **Marks:** 2.

Final Answer: The correct answer is $\Rightarrow$ C

Answer: (C) Go Back to B26

B27.

Solution

Concept — Resonance: Identify the relevant concept, formula or rule and apply it to the given data.

Reasoning: Resonance occurs near the natural frequency, producing large response if damping is low.

Question Type: MCQ; **Marks:** 2.

Final Answer: The correct answer is $\Rightarrow$ B

Answer: (B) Go Back to B27

B28.

Solution

Concept — Gyroscope: Identify the relevant concept, formula or rule and apply it to the given data.

Reasoning: Gyroscopic action is tied to angular momentum and resistance to changes in spin-axis orientation.

Question Type: MCQ; **Marks:** 2.

Final Answer: The correct answer is ⇒ A

Answer: (A) Go Back to B28

B29.

Solution

Concept — Critical Speed: Identify the relevant concept, formula or rule and apply it to the given data.

Reasoning: rpm = 30 cycles/s x 60 = 1800 rpm.

Question Type: NAT; **Marks:** 2.

Final Answer: The correct answer is ⇒ 1800

Answer: (1800) Go Back to B29

B210.

Solution

Concept — Bolted Joints: Identify the relevant concept, formula or rule and apply it to the given data.

Reasoning: Bolt preload clamps members and helps resist separation and fatigue loading.

Question Type: MCQ; **Marks:** 2.

Final Answer: The correct answer is ⇒ A

Answer: (A) Go Back to B210

B211.

Solution

Concept — Welded Joints: Identify the relevant concept, formula or rule and apply it to the given data.

Reasoning: Fillet welds are common in lap, tee and corner joints.

Question Type: MCQ; **Marks:** 2.

Final Answer: The correct answer is $\Rightarrow$ B

Answer: (B) Go Back to B211

B212.

Solution

Concept — Springs: Identify the relevant concept, formula or rule and apply it to the given data.

Reasoning: Parallel spring stiffnesses add: k_eq = 100 + 200 = 300 N/m.

Question Type: NAT; **Marks:** 2.

Final Answer: The correct answer is $\Rightarrow$ 300

Answer: (300) Go Back to B212

B213.

Solution

Concept — Brakes and Clutches: Identify the relevant concept, formula or rule and apply it to the given data.

Reasoning: A clutch connects or disconnects driving and driven shafts.

Question Type: MCQ; **Marks:** 2.

Final Answer: The correct answer is $\Rightarrow$ C

Answer: (C) Go Back to B213

B214.

Solution

Concept — CAD/CAM: Identify the relevant concept, formula or rule and apply it to the given data.

Reasoning: CAD/CAM integration uses digital design data for planning and manufacturing.

Question Type: MCQ; **Marks:** 2.

Final Answer: The correct answer is $\Rightarrow$ D

Answer: (D) Go Back to B214

B215.

Solution

Concept — Machine Design: Identify the relevant concept, formula or rule and apply it to the given data.

Reasoning: Factor of safety compares failure capacity with allowable or working demand.

Question Type: MCQ; **Marks:** 2.

Final Answer: The correct answer is $\Rightarrow$ A

Answer: (A) Go Back to B215

Answer Key

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
GA1	A	GA2	B	GA3	10	GA4	C	GA5	3
GA6	150	GA7	D	GA8	0.5	GA9	A	GA10	15
A1	A	A2	2	A3	3	A4	B	A5	4
A6	3	A7	C	A8	D	A9	90	A10	A
A11	B	A12	C	A13	D	A14	A	A15	B
A16	C	A17	1	A18	3	A19	D	A20	A
A21	B	A22	C	A23	D	A24	A	A25	B
A26	ABC	A27	C	A28	D	A29	A	A30	B
A31	ABC	A32	C	A33	2	A34	D	A35	A
A36	1	A37	2	A38	B	A39	3	A40	C
B11	A	B12	B	B13	1024	B14	C	B15	D
B16	A	B17	B	B18	C	B19	D	B110	A
B111	B	B112	C	B113	D	B114	A	B115	B
B21	D	B22	C	B23	B	B24	A	B25	D
B26	C	B27	B	B28	A	B29	1800	B210	A
B211	B	B212	300	B213	C	B214	D	B215	A