GATE Robotics and Automation (RA)

Sample Paper – 3

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 grammatically correct sentence.

(A) The robots were tested.

(B) The robots was tested.

(C) The robot were testing.

(D) The robots is tested.

GA2. **[MCQ, 1 mark]** Choose the word closest in meaning to 'redundant'.

(A) Essential

(B) Unnecessary

(C) Accurate

(D) Automatic

GA3. **[NAT, 1 mark]** A robot inspection cycle improves from 50 s to 40 s. Find the percentage reduction. *Answer type: Numerical Answer Type (enter the value).*

GA4. **[MCQ, 1 mark]** If all calibrated cameras pass test T and camera C does not pass test T, which conclusion follows?

(A) C is calibrated

(B) All cameras fail

(C) C is not calibrated

(D) No camera is calibrated

GA5. **[NAT, 1 mark]** The average of 5, 7, 9 and x is 8. Find x. *Answer type: Numerical Answer Type (enter the value).*

GA6. **[NAT, 2 marks]** An AGV travels 72 m in 24 s. Its speed in m/s is: *Answer type: Numerical Answer Type (enter the value).*

GA7. **[MCQ, 2 marks]** A lot has 8 good encoders and 2 defective encoders. One encoder is selected. Probability of selecting a good encoder is:

(A) 0.2

(B) 0.5

(C) 1.0

(D) 0.8

GA8. **[NAT, 2 marks]** Four identical robotic cells make 120 parts in 3 hours. How many parts will 6 such cells make in 2 hours? *Answer type: Numerical Answer Type (enter the value).*

GA9. **[MCQ, 2 marks]** A controller has delays 4 ms, 5 ms, 6 ms and 9 ms. The median delay is:

(A) 5.5 ms

(B) 4.5 ms

(C) 6.5 ms

(D) 9 ms

GA10. **[NAT, 2 marks]** The ratio of mobile robots to fixed robots is 3:2. If there are 50 robots, how many are mobile? *Answer type: Numerical Answer Type (enter the value).*

Part A - Common Robotics and Automation Section

A1. **[NAT, 1 mark]** Find the trace of matrix [[2, 1], [4, 5]]. *Answer type: Numerical Answer Type (enter the value).*

A2. **[NAT, 1 mark]** If f(x) = 4x^2, find f'(3). *Answer type: Numerical Answer Type (enter the value).*

A3. **[NAT, 1 mark]** Evaluate the integral of 3x^2 from 0 to 2. *Answer type: Numerical Answer Type (enter the value).*

A4. **[MCQ, 1 mark]** The solution of dy/dt = 3y is proportional to:

(A) e^(3t)

(B) e^(-3t)

(C) 3t

(D) sin t

A5. **[MCQ, 1 mark]** For a Bernoulli random variable with success probability p, the mean is:

(A) 1 - p

(B) p

(C) p^2

(D) 2p

A6. **[MCQ, 1 mark]** Newton-Raphson method uses which local information?

(A) Only final answer

(B) Only random samples

(C) Function value and derivative

(D) Only matrix rank

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

(A) Energy

(B) Mass density

(C) Momentum

(D) Charge

A8. **[MCQ, 1 mark]** The impedance of an ideal capacitor decreases when frequency:

(A) Increases

(B) Decreases

(C) Becomes zero always

(D) Is not defined

A9. **[MCQ, 1 mark]** The NAND gate is called universal because:

(A) It stores analog signals

(B) It can implement any Boolean function

(C) It measures torque

(D) It works only as an inverter

A10. **[NAT, 1 mark]** An encoder gives 500 pulses per revolution. How many pulses occur in 3 revolutions? *Answer type: Numerical Answer Type (enter the value).*

A11. **[MCQ, 1 mark]** A thermocouple is commonly used to measure:

(A) Torque only

(B) Displacement

(C) Temperature

(D) Flow direction only

A12. **[MCQ, 1 mark]** A strain gauge changes its resistance mainly due to:

(A) Program size

(B) Colour change

(C) Barcode length

(D) Mechanical strain

A13. **[MCQ, 1 mark]** A servo drive uses feedback mainly to reduce:

(A) Tracking error

(B) Paint thickness

(C) File size

(D) Bearing diameter

A14. **[MCQ, 1 mark]** Hydraulic systems use which medium to transmit power?

(A) Vacuum only

(B) Liquid

(C) Dry air only

(D) Light only

A15. **[NAT, 1 mark]** A 20 N force acts at a perpendicular distance of 0.5 m from a pivot. Torque in N m is: *Answer type: Numerical Answer Type (enter the value).*

A16. **[NAT, 1 mark]** In Python, len(range(0, 10, 2)) returns: *Answer type: Numerical Answer Type (enter the value).*

A17. **[MCQ, 1 mark]** A priority queue is commonly implemented using a:

(A) Op-amp

(B) Thermocouple

(C) Heap

(D) Pulley

A18. **[MCQ, 1 mark]** An adjacency matrix for a graph with n vertices has size:

(A) 2 by n only

(B) n by 1

(C) 1 by n

(D) n by n

A19. **[MCQ, 1 mark]** Denavit-Hartenberg parameters are used for:

(A) Robot kinematic modelling

(B) Casting only

(C) Sampling only

(D) Welding current only

A20. **[NAT, 1 mark]** A free rigid body in 3D has how many total degrees of freedom? *Answer type: Numerical Answer Type (enter the value).*

A21. **[MCQ, 2 marks]** A 180 degree rotation about the z-axis maps point (1, 2, 0) to:

(A) (1, -2, 0)

(B) (-1, -2, 0)

(C) (-1, 2, 0)

(D) (2, 1, 0)

A22. **[MCQ, 2 marks]** A planar 2R arm has link lengths 2 m and 1 m, with q1 = 0 degree and q2 = 0 degree. The end point is:

(A) (1, 2)

(B) (2, 1)

(C) (3, 0)

(D) (0, 3)

A23. **[MCQ, 2 marks]** A manipulator singularity is a configuration where the Jacobian:

(A) Has no units only

(B) Becomes a colour map

(C) Must be identity always

(D) Loses rank

A24. **[MCQ, 2 marks]** A redundant manipulator has:

(A) More joint DOF than task DOF

(B) No joints

(C) Only one possible posture always

(D) Zero workspace

A25. **[NAT, 2 marks]** A differential drive robot has both wheels of radius 0.1 m rotating at 10 rad/s. Forward speed in m/s is: *Answer type: Numerical Answer Type (enter the value).*

A26. **[NAT, 2 marks]** A joint moves from 0 rad to 2 rad in 4 s with constant velocity. Velocity in rad/s is: *Answer type: Numerical Answer Type (enter the value).*

A27. **[MCQ, 2 marks]** Increasing derivative gain in a PID loop usually improves:

(A) Sensor resolution only

(B) Damping

(C) Motor colour

(D) Gear tooth count

A28. **[MCQ, 2 marks]** A PLC interlock is used mainly to:

(A) Reduce ADC bits

(B) Increase backlash

(C) Prevent unsafe or conflicting operations

(D) Paint a robot

A29. **[MCQ, 2 marks]** In CNC programming, G02 commonly indicates:

(A) Tool wear alarm only

(B) Linear interpolation

(C) Program end only

(D) Clockwise circular interpolation

A30. **[MCQ, 2 marks]** Camera calibration mainly estimates:

(A) Intrinsic and extrinsic parameters

(B) Battery chemistry only

(C) Hydraulic oil density only

(D) PLC scan delay only

A31. **[MCQ, 2 marks]** A Kalman filter is used to:

(A) Cut a gear tooth

(B) Estimate state from noisy measurements

(C) Store a stack only

(D) Increase friction

A32. **[MSQ, 2 marks]** Which sensors can help a mobile robot estimate pose?

(A) Wheel encoders

(B) IMU

(C) Camera

(D) Paint sprayer nozzle

A33. **[MCQ, 2 marks]** A 2D lidar primarily provides:

(A) Only ADC levels

(B) Only joint torque

(C) Range scans around a plane

(D) Only temperature

A34. **[NAT, 2 marks]** A motor delivers torque 4 N m at speed 20 rad/s. Mechanical power in watts is: *Answer type: Numerical Answer Type (enter the value).*

A35. **[NAT, 2 marks]** A gear reducer has input speed 1200 rpm and reduction ratio 4:1. Output speed in rpm is: *Answer type: Numerical Answer Type (enter the value).*

A36. **[MCQ, 2 marks]** A double-acting pneumatic cylinder can exert force:

(A) Only when unpressurized

(B) Only in extension

(C) Only in retraction

(D) In both extension and retraction

A37. **[MCQ, 2 marks]** The main advantage of ASRS is:

(A) Automated high-density storage and retrieval

(B) Higher manual walking only

(C) No inventory tracking

(D) Only visual decoration

A38. **[MCQ, 2 marks]** A light curtain in a robotic cell is used to:

(A) Increase motor torque

(B) Detect intrusion into a protected area

(C) Reduce memory

(D) Measure humidity only

A39. **[MCQ, 2 marks]** Breadth-first search on an unweighted graph gives:

(A) ADC resolution

(B) Maximum torque

(C) Shortest path in number of edges

(D) Only sorted arrays

A40. **[MCQ, 2 marks]** Binary search on a sorted array has time complexity:

(A) O(1) always

(B) O(n ^ 2)

(C) O(n!)

(D) O(log n)

Part B1 - Electrical Engineering Optional

B11. **[MCQ, 1 mark]** An ideal op-amp in negative feedback has approximately:

(A) Equal input terminal voltages

(B) Zero gain

(C) Infinite output impedance

(D) No supply rails

B12. **[MCQ, 1 mark]** A notch filter is designed to reject:

(A) All frequencies

(B) A narrow frequency band

(C) Only DC

(D) Only mechanical motion

B13. **[NAT, 1 mark]** A 12-bit ADC has how many quantization levels? *Answer type: Numerical Answer Type (enter the value).*

B14. **[MCQ, 1 mark]** PWM is often used to control:

(A) Material density

(B) Beam length

(C) Average motor voltage

(D) File name

B15. **[MCQ, 1 mark]** A watchdog timer is used to:

(A) Increase ADC input impedance only

(B) Measure shaft strain

(C) Store hydraulic fluid

(D) Recover from software lockup

B16. **[NAT, 2 marks]** For R = 10 kohm and C = 10 microfarad, the time constant in seconds is: *Answer type: Numerical Answer Type (enter the value).*

B17. **[MCQ, 2 marks]** The characteristic equation of a unity-feedback system with loop transfer G(s) is:

(A) 1 + G(s) = 0

(B) G(s) = 0 only

(C) 1 - s = 0 always

(D) H(s) = infinity

B18. **[NAT, 2 marks]** For damping ratio 0.5 and natural frequency 4 rad/s, approximate settling time using 4/(zeta wn) is: *Answer type: Numerical Answer Type (enter the value).*

B19. **[MCQ, 2 marks]** Root locus branches start at:

(A) Open-loop zeros only

(B) Open-loop poles

(C) Closed-loop zeros only

(D) Origin always

B110. **[MSQ, 2 marks]** Which matrices appear in the standard state-space model xdot = Ax + Bu, y = Cx + Du?

(A) A

(B) B

(C) C

(D) E

B111. **[MCQ, 2 marks]** A pole of a discrete-time system is stable if it lies:

(A) Only on real axis greater than 1

(B) Outside the unit circle

(C) Inside the unit circle

(D) At infinity

B112. **[MCQ, 2 marks]** Aliasing occurs when the sampling frequency is:

(A) Only DC

(B) Infinite

(C) Exactly zero noise

(D) Too low

B113. **[MCQ, 2 marks]** A pure time delay contributes:

(A) Phase lag increasing with frequency

(B) Magnitude increase only

(C) Zero phase shift

(D) No frequency response

B114. **[NAT, 2 marks]** A 4-bit DAC with 5 V full-scale has ideal step size 5/16 V. Give the step size in volts. *Answer type: Numerical Answer Type (enter the value).*

B115. **[MCQ, 2 marks]** An H-bridge is commonly used for:

(A) Measuring pH

(B) Bidirectional DC motor control

(C) Beam bending only

(D) Database indexing

Part B2 - Mechanical Engineering Optional

B21. **[MCQ, 1 mark]** Shear stress is force divided by:

(A) Memory size

(B) Voltage

(C) Angular speed

(D) Area parallel to the force

B22. **[MCQ, 1 mark]** Engineering strain is change in length divided by:

(A) Torque

(B) Final load

(C) Original length

(D) Speed

B23. **[MCQ, 1 mark]** The point of contraflexure in a beam is where bending moment:

(A) Is maximum only

(B) Changes sign

(C) Is always zero shear

(D) Equals axial load

B24. **[MCQ, 1 mark]** A rolling contact bearing reduces friction by using:

(A) Rolling elements

(B) Only adhesive

(C) Only hydraulic oil

(D) No motion

B25. **[MCQ, 1 mark]** Backlash in gears is:

(A) Weld length

(B) Bearing diameter

(C) ADC count

(D) Clearance between mating teeth

B26. **[NAT, 2 marks]** A shaft transmits torque 50 N m at angular speed 20 rad/s. Power in watts is: *Answer type: Numerical Answer Type (enter the value).*

B27. **[NAT, 2 marks]** Two springs of stiffness 100 N/m and 300 N/m are in series. Equivalent stiffness in N/m is: *Answer type: Numerical Answer Type (enter the value).*

B28. **[NAT, 2 marks]** For mass 5 kg and stiffness 500 N/m, natural frequency in rad/s is: *Answer type: Numerical Answer Type (enter the value).*

B29. **[MCQ, 2 marks]** Euler buckling load increases when effective length:

(A) Becomes imaginary

(B) Increases

(C) Decreases

(D) Has no effect

B210. **[MCQ, 2 marks]** Endurance limit is most relevant for:

(A) ADC conversion

(B) Fatigue design

(C) Robot grammar

(D) Heap sorting

B211. **[MCQ, 2 marks]** The radius of Mohr's circle represents:

(A) Maximum in-plane shear stress

(B) Only normal strain zero

(C) Mass moment of inertia

(D) Gear module

B212. **[MCQ, 2 marks]** A lock washer is used mainly to:

(A) Reduce loosening of a threaded joint

(B) Increase ADC resolution

(C) Measure temperature

(D) Cut threads automatically

B213. **[NAT, 2 marks]** A brake applies tangential friction force 100 N at radius 0.2 m. Braking torque in N m is: *Answer type: Numerical Answer Type (enter the value).*

B214. **[MCQ, 2 marks]** In FEA, mesh refinement generally means:

(A) Using fewer nodes only

(B) Using smaller elements

(C) Deleting boundary conditions

(D) Ignoring material data

B215. **[MCQ, 2 marks]** Support structures are often needed in additive manufacturing to:

(A) Stop slicing

(B) Increase backlash

(C) Hold overhanging features

(D) Remove the CAD model

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: The plural subject 'robots' takes the plural verb 'were'.

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

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

Answer: (A) Go Back to GA1

GA2.

Solution

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

Reasoning: Redundant means unnecessary or more than what is needed.

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

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

Answer: (B) Go Back to GA2

GA3.

Solution

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

Reasoning: Reduction is 10 s out of 50 s, so percentage reduction is 20.

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

Final Answer: The correct answer is $\Rightarrow$ 20

Answer: (20) Go Back to GA3

GA4.

Solution

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

Reasoning: By contrapositive, not passing test T means the camera is not calibrated.

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

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

Answer: (C) Go Back to GA4

GA5.

Solution

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

Reasoning: The total must be 32. The known total is 21, so x = 11.

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

Final Answer: The correct answer is $\Rightarrow$ 11

Answer: (11) Go Back to GA5

GA6.

Solution

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

Reasoning: Speed is distance divided by time, so 72/24 = 3 m/s.

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

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

Answer: (3) Go Back to GA6

GA7.

Solution

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

Reasoning: There are 8 good encoders out of 10 total, so probability is 0.8.

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

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

Answer: (D) Go Back to GA7

GA8.

Solution

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

Reasoning: One cell makes 10 parts per hour. Six cells for two hours make 6 x 2 x 10 = 120 parts.

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

Final Answer: The correct answer is $\Rightarrow$ 120

Answer: (120) Go Back to GA8

GA9.

Solution

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

Reasoning: For four sorted values, median is the average of middle two: (5 + 6)/2 = 5.5 ms.

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

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

Answer: (A) Go Back to GA9

GA10.

Solution

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

Reasoning: Total parts of the ratio are 5. Mobile robots = 3/5 x 50 = 30.

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

Final Answer: The correct answer is ⇒ $\boxed{30}$

Answer: (30) 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: Trace is the sum of diagonal elements, so 2 + 5 = 7.

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

Final Answer: The correct answer is ⇒ $\boxed{7}$

Answer: (7) Go Back to A1

A2.

Solution

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

Reasoning: f'(x) = 8x, so f'(3) = 24.

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

Final Answer: The correct answer is ⇒ $\boxed{24}$

Answer: (24) Go Back to A2

A3.

Solution

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

Reasoning: The antiderivative is x ^ 3. From 0 to 2, the value is 8.

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

Final Answer: The correct answer is ⇒ 8

Answer: (8) Go Back to A3

A4.

Solution

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

Reasoning: The equation has exponential solution y = C e ^ (3t).

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

Final Answer: The correct answer is ⇒ A

Answer: (A) Go Back to A4

A5.

Solution

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

Reasoning: The mean of a Bernoulli random variable is p.

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

Final Answer: The correct answer is ⇒ B

Answer: (B) Go Back to A5

A6.

Solution

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

Reasoning: Newton-Raphson updates use both f(x) and f'(x).

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

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

Answer: (C) Go Back to A6

A7.

Solution

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

Reasoning: KCL follows from conservation of electric charge at a node.

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

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

Answer: (D) Go Back to A7

A8.

Solution

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

Reasoning: Capacitive reactance is 1/(omega C), so it decreases as frequency increases.

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

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

Answer: (A) Go Back to A8

A9.

Solution

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

Reasoning: NAND gates can be combined to form NOT, AND, OR and other logic functions.

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

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

Answer: (B) Go Back to A9

A10.

Solution

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

Reasoning: Pulse count = 500 x 3 = 1500.

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

Final Answer: The correct answer is $\Rightarrow$ 1500

Answer: (1500) Go Back to A10

A11.

Solution

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

Reasoning: A thermocouple produces a voltage related to temperature difference.

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

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

Answer: (C) Go Back to A11

A12.

Solution

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

Reasoning: Strain changes the gauge dimensions and resistance.

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

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

Answer: (D) Go Back to A12

A13.

Solution

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

Reasoning: Feedback compares output with command and reduces tracking error.

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

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

Answer: (A) Go Back to A13

A14.

Solution

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

Reasoning: Hydraulic systems transmit power through pressurized liquid.

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

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

Answer: (B) Go Back to A14

A15.

Solution

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

Reasoning: Torque = force x moment arm = 20 x 0.5 = 10 N m.

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

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

Answer: (10) Go Back to A15

A16.

Solution

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

Reasoning: The sequence is 0, 2, 4, 6, 8, so length is 5.

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

Final Answer: The correct answer is ⇒ $\boxed{5}$

Answer: (5) Go Back to A16

A17.

Solution

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

Reasoning: Heaps are common implementations of priority queues.

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

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

Answer: (C) Go Back to A17

A18.

Solution

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

Reasoning: An adjacency matrix stores pairwise vertex connections, so it is n by n.

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

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

Answer: (D) Go Back to A18

A19.

Solution

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

Reasoning: DH parameters describe relative link and joint transformations in serial robots.

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

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

Answer: (A) Go Back to A19

A20.

Solution

Concept — Rigid Body Motion: 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:** 1.

Final Answer: The correct answer is $\Rightarrow$ 6

Answer: (6) Go Back to A20

A21.

Solution

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

Reasoning: A 180 degree z-rotation changes x and y signs, giving (-1, -2, 0).

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

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

Answer: (B) Go Back to A21

A22.

Solution

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

Reasoning: Both links align with the x-axis, so total reach is $2 + 1 = 3$ m along x.

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

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

Answer: (C) Go Back to A22

A23.

Solution

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

Reasoning: At a singularity, the Jacobian loses rank and some Cartesian motions become impossible or ill-conditioned.

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

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

Answer: (D) Go Back to A23

A24.

Solution

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

Reasoning: Redundancy means extra joint degrees of freedom relative to the task requirement.

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

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

Answer: (A) Go Back to A24

A25.

Solution

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

Reasoning: For equal wheel speeds, forward speed is r omega = 0.1 x 10 = 1 m/s.

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

Final Answer: The correct answer is $\Rightarrow$ 1

Answer: (1) Go Back to A25

A26.

Solution

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

Reasoning: Velocity = displacement/time = 2/4 = 0.5 rad/s.

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

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

Answer: (0.5) Go Back to A26

A27.

Solution

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

Reasoning: Derivative action adds damping by responding to the rate of change of error.

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

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

Answer: (B) Go Back to A27

A28.

Solution

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

Reasoning: Interlocks prevent actions unless required safety or process conditions are satisfied.

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

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

Answer: (C) Go Back to A28

A29.

Solution

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

Reasoning: G02 is commonly used for clockwise circular interpolation.

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

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

Answer: (D) Go Back to A29

A30.

Solution

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

Reasoning: Calibration estimates camera internal parameters and pose relative to a world or robot frame.

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

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

Answer: (A) Go Back to A30

A31.

Solution

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

Reasoning: A Kalman filter combines a model and noisy measurements to estimate system state.

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

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

Answer: (B) Go Back to A31

A32.

Solution

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

Reasoning: Encoders, IMUs and cameras can contribute to pose estimation.

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

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

Answer: (ABC) Go Back to A32

A33.

Solution

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

Reasoning: A 2D lidar measures distances along directions in a scanning plane.

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

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

Answer: (C) Go Back to A33

A34.

Solution

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

Reasoning: Power = torque x angular speed = 4 x 20 = 80 W.

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

Final Answer: The correct answer is $\Rightarrow$ 80

Answer: (80) Go Back to A34

A35.

Solution

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

Reasoning: Output speed = 1200/4 = 300 rpm.

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

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

Answer: (300) Go Back to A35

A36.

Solution

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

Reasoning: A double-acting cylinder uses pressure on either side of the piston.

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

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

Answer: (D) Go Back to A36

A37.

Solution

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

Reasoning: ASRS improves storage density, retrieval speed and inventory control.

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

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

Answer: (A) Go Back to A37

A38.

Solution

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

Reasoning: A light curtain detects when a person or object enters a guarded zone.

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

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

Answer: (B) Go Back to A38

A39.

Solution

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

Reasoning: BFS explores by levels, so it finds the shortest path in edge count for unweighted graphs.

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

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

Answer: (C) Go Back to A39

A40.

Solution

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

Reasoning: Binary search halves the search interval each step, giving logarithmic time.

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

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

Answer: (D) Go Back to A40

Part B1 - Electrical Engineering Optional

B11.

Solution

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

Reasoning: Negative feedback drives the input differential voltage close to zero for an ideal op-amp.

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

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

Answer: (A) Go Back to B11

B12.

Solution

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

Reasoning: A notch filter strongly attenuates a narrow frequency band.

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

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

Answer: (B) Go Back to B12

B13.

Solution

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

Reasoning: A 12-bit ADC has $2 \hat{} 12 = 4096$ levels.

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

Final Answer: The correct answer is $\Rightarrow$ 4096

Answer: (4096) Go Back to B13

B14.

Solution

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

Reasoning: PWM changes duty cycle to control average applied voltage or power.

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

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

Answer: (C) Go Back to B14

B15.

Solution

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

Reasoning: A watchdog timer resets or recovers a system if software stops servicing it.

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

Final Answer: The correct answer is ⇒ D

Answer: (D) Go Back to B15

B16.

Solution

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

Reasoning: RC = 10000 x 10 x 10 ^ -6 = 0.1 s.

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

Final Answer: The correct answer is ⇒ 0.1

Answer: (0.1) Go Back to B16

B17.

Solution

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

Reasoning: Closed-loop poles satisfy 1 + G(s) = 0 for unity negative feedback.

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

Final Answer: The correct answer is ⇒ A

Answer: (A) Go Back to B17

B18.

Solution

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

Reasoning: Settling time = 4/(0.5 x 4) = 2 s.

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

Final Answer: The correct answer is ⇒ 2

Answer: (2) Go Back to B18

B19.

Solution

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

Reasoning: Root locus branches start from open-loop poles and terminate at open-loop zeros or infinity.

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

Final Answer: The correct answer is ⇒ B

Answer: (B) Go Back to B19

B110.

Solution

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

Reasoning: The standard continuous-time state-space model uses A, B, C and D matrices.

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

Final Answer: The correct answer is ⇒ ABC

Answer: (ABC) Go Back to B110

B111.

Solution

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

Reasoning: Discrete-time stability requires poles inside the unit circle.

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

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

Answer: (C) Go Back to B111

B112.

Solution

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

Reasoning: Aliasing occurs when sampling violates the Nyquist requirement.

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

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

Answer: (D) Go Back to B112

B113.

Solution

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

Reasoning: A time delay has unity magnitude and phase lag proportional to frequency.

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

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

Answer: (A) Go Back to B113

B114.

Solution

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

Reasoning: Step size = 5/16 = 0.3125 V.

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

Final Answer: The correct answer is ⇒ 0.3125

Answer: (0.3125) Go Back to B114

B115.

Solution

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

Reasoning: An H-bridge can reverse voltage polarity across a DC motor.

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

Final Answer: The correct answer is ⇒ B

Answer: (B) Go Back to B115

Part B2 - Mechanical Engineering Optional

B21.

Solution

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

Reasoning: Shear stress is tangential force per unit area.

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

Final Answer: The correct answer is ⇒ D

Answer: (D) Go Back to B21

B22.

Solution

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

Reasoning: Engineering strain = change in length/original length.

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

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

Answer: (C) Go Back to B22

B23.

Solution

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

Reasoning: At a point of contraflexure, bending moment changes sign.

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

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

Answer: (B) Go Back to B23

B24.

Solution

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

Reasoning: Rolling elements reduce sliding friction.

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

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

Answer: (A) Go Back to B24

B25.

Solution

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

Reasoning: Backlash is the intentional clearance between meshing gear teeth.

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

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

Answer: (D) Go Back to B25

B26.

Solution

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

Reasoning: Power = torque x angular speed = 50 x 20 = 1000 W.

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

Final Answer: The correct answer is $\Rightarrow$ $\boxed{1000}$

Answer: (1000) Go Back to B26

B27.

Solution

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

Reasoning: For series springs, $1/k = 1/100 + 1/300 = 4/300$, so $k = 75$ N/m.

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

Final Answer: The correct answer is $\Rightarrow$ $\boxed{75}$

Answer: (75) Go Back to B27

B28.

Solution

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

Reasoning: Natural frequency = sqrt(k/m) = sqrt(500/5) = 10 rad/s.

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

Final Answer: The correct answer is ⇒ 10

Answer: (10) Go Back to B28

B29.

Solution

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

Reasoning: Euler buckling load is inversely proportional to effective length squared.

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

Final Answer: The correct answer is ⇒ C

Answer: (C) Go Back to B29

B210.

Solution

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

Reasoning: The endurance limit is used in fatigue analysis under repeated loading.

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

Final Answer: The correct answer is ⇒ B

Answer: (B) Go Back to B210

B211.

Solution

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

Reasoning: The radius represents maximum shear stress in the transformed plane-stress state.

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

Final Answer: The correct answer is ⇒ A

Answer: (A) Go Back to B211

B212.

Solution

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

Reasoning: Lock washers help resist loosening under vibration.

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

Final Answer: The correct answer is ⇒ A

Answer: (A) Go Back to B212

B213.

Solution

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

Reasoning: Torque = force x radius = 100 x 0.2 = 20 N m.

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

Final Answer: The correct answer is ⇒ 20

Answer: (20) Go Back to B213

B214.

Solution

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

Reasoning: Refinement uses smaller or more elements to improve solution resolution.

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

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

Answer: (B) Go Back to B214

B215.

Solution

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

Reasoning: Supports help build overhangs and prevent collapse or distortion.

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

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

Answer: (C) Go Back to B215

Answer Key

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
GA1	A	GA2	B	GA3	20	GA4	C	GA5	11
GA6	3	GA7	D	GA8	120	GA9	A	GA10	30
A1	7	A2	24	A3	8	A4	A	A5	B
A6	C	A7	D	A8	A	A9	B	A10	1500
A11	C	A12	D	A13	A	A14	B	A15	10
A16	5	A17	C	A18	D	A19	A	A20	6
A21	B	A22	C	A23	D	A24	A	A25	1
A26	0.5	A27	B	A28	C	A29	D	A30	A
A31	B	A32	ABC	A33	C	A34	80	A35	300
A36	D	A37	A	A38	B	A39	C	A40	D
B11	A	B12	B	B13	4096	B14	C	B15	D
B16	0.1	B17	A	B18	2	B19	B	B110	ABC
B111	C	B112	D	B113	A	B114	0.3125	B115	B
B21	D	B22	C	B23	B	B24	A	B25	D
B26	1000	B27	75	B28	10	B29	C	B210	B
B211	A	B212	A	B213	20	B214	B	B215	C