



ICSE 2027 EXAMINATION
SPECIMEN QUESTION PAPER
ROBOTICS AND ARTIFICIAL INTELLIGENCE

Maximum Marks: 100

*Time allowed: **Two hours***

Answers to this Paper must be written on the paper provided separately.

*You will **not** be allowed to write during the first **15 minutes**.*

This time is to be spent in reading the question paper.

The time given at the head of this Paper is the time allowed for writing the answers.

*Attempt **all** questions from **Section A** and **any four** questions from **Section B**.*

The intended marks for questions or parts of questions are given in brackets [].

Instruction for the Supervising Examiner

Kindly read aloud the Instructions given above to all the candidates present in the Examination Hall.

NOTE:

The Specimen Question Paper in the subject provides a realistic format of the Board Examination Question Paper and should be used as a practice tool. The questions for the Board Examination can be set from any part of the syllabus. However, the format of the Board Examination Question Paper will remain the same as that of the Specimen Question Paper.

SECTION A (40 Marks)

(Attempt all questions.)

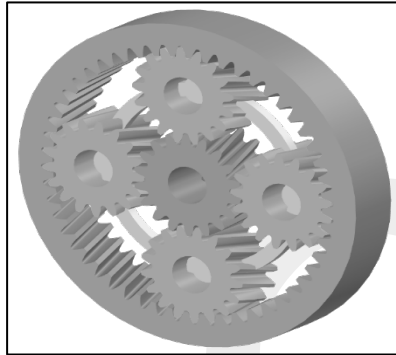
Question 1

[20]

Choose the correct answers to the questions from the given options.

(Do not copy the question, write the correct answers only.)

- (i) Identify the gear shown in the image given below:



- (a) Bevel
- (b) Worm
- (c) Planetary
- (d) Spur

[Recall]

- (ii) A city installs intelligent traffic signals that adjust signal timings based on real-time traffic flow. This is an example of:

- (a) Traditional automation
- (b) New Age Robotic System
- (c) Mechanical control system
- (d) Manual traffic regulation

[Understanding]

- (iii) A student is preparing a presentation on examples of New Age Robotic Systems. Which of the following should **NOT** be included in the presentation?

- (a) Autonomous delivery robot
- (b) Smart vacuum cleaner
- (c) Collaborative robot
- (d) Mechanical screwdriver

[Understanding]

(iv) Robots are used in _____ to monitor crop health.

- (a) Warehouse
- (b) Healthcare
- (c) Agriculture
- (d) Industrial automation

[Recall]

(v) A robot detects the presence of an obstacle in its path. _____ sensor is used for this.

- (a) Tactile
- (b) Force
- (c) Temperature
- (d) Proximity

[Recall]

(vi) Which of the following devices is commonly found in a smart home?

- (a) Conventional microwave oven
- (b) Roomba vacuum cleaner
- (c) Desktop computer
- (d) Compass

[Recall]

(vii) Which software tool is commonly used by students to design and simulate robotic components virtually?

- (a) Python
- (b) Tinkercad
- (c) Notepad++
- (d) Unity

[Recall]

(viii) A robotic component moves back and forth along a straight line without rotating. This movement is produced by a _____ joint.

- (a) Revolute
- (b) Prismatic
- (c) Torsional
- (d) Flexible

[Recall]

(ix) A robot designed to move on a flat surface using wheels for locomotion is a:

- (a) Flying robot
- (b) Legged robot
- (c) Wheeled mobile robot
- (d) Stationary robot

[Recall]

(x) A spam email detection system classifies incoming emails as "Spam" or "Not Spam" based on features such as keywords, sender information and attachments. Which factor is primarily used by the system to make its decision?

- (a) Personal preference
- (b) Random selection
- (c) Measured data
- (d) Human emotions

[Understanding]

(xi) What is the first step in developing a Machine Learning system to recognise traffic signs for autonomous vehicles?

- (a) Writing the final algorithm
- (b) Collecting and organising data
- (c) Making predictions
- (d) Training the robot physically

[Recall]

(xii) What is the first stage of the AI Project Framework?

- (a) Data Acquisition
- (b) Modelling
- (c) Problem Scoping
- (d) Evaluation

[Recall]

(xiii) What do the 4 W's in AI problem scoping stand for?

- (a) Who, What, Why, When
- (b) Who, What, Where, Why
- (c) Why, Where, When, What
- (d) Where, Who, What, When

[Recall]

(xiv) An AI system follows predefined IF–THEN rules and does not learn from new data. This system is best described as:

- (a) Learning-based AI
- (b) Supervised learning system
- (c) Unsupervised learning system
- (d) Rule-based AI system

[Understanding]

(xv) What will be the output of the following Python code?

```
x = 5  
print(x + 2)
```

- (a) 5
- (b) 2
- (c) 7
- (d) 52

[Application]

(xvi) What will be the output of the following Python code?

```
numbers = [10, 20, 30]
```

```
print(len(numbers))
```

- (a) 2
- (b) 3
- (c) 20
- (d) 30

[Application]

(xvii) **Statement I:** All machines are robots.

Statement II: Robots are only controlled manually and cannot work autonomously.

- (a) Both statements I and II are correct.
- (b) Both statements I and II are incorrect.
- (c) Statement I is correct, but statement II is incorrect.
- (d) Statement I is incorrect, but statement II is correct.

[Understanding]

(xviii) **Statement I:** A gear system can be used to amplify force in robotic joints.

Statement II: Changing the gear ratio changes the torque and speed in the system.

- (a) Both statements I and II are correct.
- (b) Both statements I and II are incorrect.
- (c) Statement I is correct, but statement II is incorrect.
- (d) Statement I is incorrect, but statement II is correct.

[Understanding]

(xix) Machine decisions are influenced by emotions and personal experiences.

- (a) True
- (b) False

[Understanding]

(xx) In a robotic system, the controller processes sensor inputs and decides the actions of actuators.

- (a) True
- (b) False

[Understanding]

Question 2

Answer the following questions:

- (i) State *any two* features that enable a robot to perform tasks with minimal human intervention. [2]
[Recall]
- (ii) Mention *any two* features that distinguish a robot from an ordinary machine. [2]
[Understanding]
- (iii) An automatic door opens when a person approaches it. What role does the controller play in this system? [2]
[Understanding]
- (iv) What is the *RR mechanism* in robotics? Mention *one* application where it is commonly used. [2]
[Recall]
- (v) “Artificial Intelligence and Machine Learning are the same.” Do you agree with the statement? Justify your answer with *one* reason. [2]
[Understanding]
- (vi) Differentiate between a *Touch Sensor* and a *Proximity Sensor*. [2]
[Understanding]
- (vii) The number of teeth on *driven gear* is 30 and on *driving gear* is 15. Find the gear ratio. [2]
[Application]
- (viii) An autonomous vehicle detects an obstacle and stops automatically. State *any two* characteristics of machine decision-making demonstrated in this situation. [2]
[Understanding]
- (ix) What is the *Turing Test*? What does it determine about a machine? [2]
[Recall]
- (x) Why is *Problem Scoping* an important stage in the AI Project Framework? [2]
[Understanding]

SECTION B (60 Marks)

(Answer **any four** questions from this Section.)

The answers in this section should consist of the programs in either python environment or any program environment with python as the base.

Question 3

Answer the following questions:

- (i) A city plans to introduce **autonomous buses** to improve public transportation. The city also wants to use AI to analyse traffic patterns and reduce congestion. [3]

Based on the above scenario:

- (a) State *one* characteristic of the autonomous bus. [Understanding]
- (b) Explain how the bus detects obstacles while moving. [Understanding]
- (c) Mention *one* advantage of using AI in managing public transportation. [Understanding]
- (ii) A company is developing an AI system to sort recyclable waste. Mention: [3]
- (a) *one* type of data required. [Understanding]
- (b) *one* factor that can improve the accuracy of the AI model. [Understanding]
- (c) *one* expected outcome. [Understanding]
- (iii) Write a Python program using the **Matplotlib** library to display the number of robots used in different sectors as shown below: [9]

Sector	Number of Robots
Healthcare	20
Agriculture	15
Manufacturing	30
Education	10

The program should:

1. Import the required Matplotlib library.
2. Create suitable lists for sectors and the corresponding number of robots.
3. Plot a **bar graph**.
4. Label the X-axis as "**Sectors**".
5. Label the Y-axis as "**Number of Robots**".
6. Give the graph a suitable title.
7. Display the graph.

[Application]

Question 4

- (i) A robotic arm in a packaging unit uses a motor, gears and a gripper to move heavy boxes from one conveyor belt to another. [3]

Based on the above information, explain:

- (a) *any one* role of gears in the robotic arm, and
- (b) *two* ways in which changing the gear ratio can affect the force and speed of movement.

[Understanding]

[Understanding]

- (ii) The employees of a company receive an email asking them to click on a link and enter their login credentials. Identify the possible cyber threat and explain *any two* precautions to be taken by the employees. [3]

[Understanding]

- (iii) Write a Python program to: [9]

1. Create a string "Hardwork pays"
2. Print the characters from index 3 to 9
3. Convert the string str to upper case and store in str1
4. Check if the string ends with 'S'. Print a boolean value as the output.
5. Replace the word 'Hardwork' with 'Earnest work'
6. Print the new string
7. Join the word 'OFF' at the end of the string

[Application]

Question 5

- (i) A delivery robot is carrying a parcel when it detects that its usual route is blocked. Explain how the robot makes decisions to complete the delivery safely. [3]
[Understanding]
- (ii) Explain *any three* factors that influence the accuracy of a Machine Learning model. [3]
[Understanding]
- (iii) With the help of a neat, labelled diagram, explain the *role* and *working* of a robotic system using the following components: [9]
[Understanding]
- Sensors
 - Controller
 - Actuators

Question 6

- (i) Discuss *any three* ways in which *Machine Intelligence* differs from *traditional computer programs*. [3]
[Understanding]
- (ii) State *any three* problems that may arise if data is not prepared properly before training a Machine Learning model. [3]
[Understanding]
- (iii) A recycling plant wants to use Tinkercad to design its waste segregation system. With reference to the given scenario, answer the following questions: [9]
- (a) Explain *two* ways in which Tinkercad can help in designing the system. [Understanding]
- (b) Mention the type of joint used for segregating wet waste and dry waste with a reason. [Understanding]
- (c) Why should the model be visualised before it is used? [Understanding]

Question 7

- (i) A robot is used in a bakery to decorate cakes. Explain *any three* features that make robots suitable for this task. [3]
[Understanding]
- (ii) State *any three* advantages of using robots in modern manufacturing industries. [3]
[Recall]
- (iii) The hospital wants to upgrade the robotic assistant with AI capabilities. Answer the following: [9]
- (a) Explain how machine learning can help the robot improve its performance over time. [Understanding]
- (b) Explain *two* cybersecurity risks that may affect the robotic assistant and measure to prevent them. [Understanding]
- (c) The robotic assistant must identify the correct medicine for each patient. Explain how AI helps the robot perform this task accurately. [Understanding]

Question 8

- (i) Explain *any three* benefits of using robotics and AI in agriculture. [3]
[Understanding]
- (ii) A supermarket plans to develop an AI system to identify products that are placed on the wrong shelves. State: [3]
- (a) *one* type of data required, [Understanding]
- (b) *one* factor that can improve the accuracy of the AI model, [Understanding]
- (c) *one* expected outcome of the system. [Understanding]
- (iii) Write a Python program that performs the following task: [9]
1. Create a tuple having elements (50,60,70,80,90).
 2. Convert the above tuple to list.
 3. Sort all the elements in descending order.

4. Remove the element 80 from the above list and print the list.
5. Sort the above in ascending order.
6. Convert the final list to tuple.
7. Print the final tuple.

[Application]

ICSE 2027 SPECIMEN

DRAFT MARKING SCHEME - ROBOTICS & ARTIFICIAL INTELLIGENCE

SECTION A (40 Marks)

Question 1		[20]
(i)	(c) Planetary	
(ii)	(b) New Age Robotic System	
(iii)	(d) Mechanical screwdriver	
(iv)	(c) Agriculture	
(v)	(d) Proximity	
(vi)	(b) Roomba vacuum cleaner	
(vii)	(b) Tinkercad	
(viii)	(b) Prismatic	
(ix)	(c) Wheeled mobile robot	
(x)	(c) Measured data	
(xi)	(b) Collecting and organising data	
(xii)	(c) Problem Scoping	
(xiii)	(b) Who, What, Where, Why	
(xiv)	(d) Rule-based AI system	
(xv)	(c) 7	
(xvi)	(b) 3	
(xvii)	(b) Both statements I and II are incorrect.	
(xviii)	(a) Both statements I and II are correct.	
(xix)	(b) False	
(xx)	(a) True	

Question 2 <i>The answers provided are indicative only. Any other correct and relevant answers, supported by appropriate reasoning where applicable, should also be accepted.</i>		
(i)	Features that enable a robot to perform tasks with minimal human intervention: • Uses sensors to detect its surroundings or changes in the environment • Processes information using a controller or AI system • Makes decisions based on sensor inputs (Any two)	[2]
(ii)	Features that distinguish a robot from an ordinary machine. • Uses sensors to take input • Performs complicated tasks • Can process information and make decisions based on the input taken • Can operate autonomously with minimal human intervention • Can respond to changes in the environment in real-time • Performs multiple tasks • Can be programmed or re-programmed to perform different tasks (Any two) Whereas, • an ordinary machine performs a single task. • It performs simpler tasks that cannot be reprogrammed.	[2]
(iii)	Receives/processes the signal from the sensor Sends commands to the actuator/motor to open the door	[1+1]
(iv)	RR (Revolute–Revolute) mechanism: A robotic mechanism consisting of two revolute joints, allowing rotational movement about two axes. Application: • Pick-and-place robotic arms • Industrial robotic manipulators • Assembly line robots • Welding robots • Material handling robots (Any one)	[1+1]
(v)	No. • AI is the broader field of creating intelligent systems • Machine Learning is a subset of AI that enables systems to learn data	[2]

(vi)	<table><tr><th>Touch Sensor</th><th>Proximity Sensor</th></tr><tr><td>Detects an object only when physical contact occurs</td><td>Detects the presence of an object without physical contact</td></tr><tr><td>Requires contact to generate a signal</td><td>Uses infrared, ultrasonic, or other sensing methods to detect nearby objects</td></tr></table> (Any two valid differences)	Touch Sensor	Proximity Sensor	Detects an object only when physical contact occurs	Detects the presence of an object without physical contact	Requires contact to generate a signal	Uses infrared, ultrasonic, or other sensing methods to detect nearby objects	[2]
Touch Sensor	Proximity Sensor							
Detects an object only when physical contact occurs	Detects the presence of an object without physical contact							
Requires contact to generate a signal	Uses infrared, ultrasonic, or other sensing methods to detect nearby objects							
(vii)	Gear ratio = $\frac{\text{No. of teeth on driven gear}}{\text{No. of gear on driving gear}}$ $= \frac{30}{15} = 2 : 1$	[2]						
(viii)	Characteristics of machine decision-making: • Decisions are based on sensor data • Decisions follow programmed rules/algorithms • Decisions are made quickly and consistently • Decisions are objective and not influenced by emotions • Decisions depend on the quality of the input data (Any two)	[2]						
(ix)	Turing Test: A test proposed by Alan Turing in which a human evaluator communicates with a machine and a human to determine whether the machine's responses are indistinguishable from those of a human. It determines whether the machine can exhibit intelligent behaviour similar to that of a human.	[1+1]						
(x)	Problem Scoping: • Clearly defines the problem to be solved • Identifies the stakeholders and their needs • Determines the objectives of the AI solution • Helps in identifying relevant data requirements • Prevents collection of unnecessary or irrelevant data • Provides direction for the subsequent stages of the AI project (Any two)	[2]						

SECTION B (60 Marks)

The answers provided are indicative only. Any other correct and relevant answers, supported by appropriate reasoning where applicable, should also be accepted.

Question 3

(i)	(a) Characteristics of the autonomous bus: - Operates autonomously with minimal human intervention - Uses sensors and AI to make decisions - Communicates with surrounding systems - Adapts to changing traffic conditions (Any one) (b) How the bus detects obstacles while moving: - An autonomous bus operates with minimal human intervention, whereas a traditional bus requires a human driver. - An autonomous bus uses sensors and AI for navigation and decision-making, whereas a traditional bus relies on human control. (Any one) (c) Advantages of using AI in managing public transportation: - Reduces traffic congestion - Improves road safety - Reduces human error - Improves transport efficiency - Optimises travel time (Any one)	[1] [1] [1]
(ii)	(a) Type of data required: - Images of recyclable and non-recyclable waste - Labelled images of waste materials - Sensor data related to waste materials - Waste classification dataset (Any one) (b) Factor that can improve accuracy: - High-quality training data - Large and diverse training dataset - Correctly labelled data - Data cleaning before training - Appropriate Machine Learning algorithm (Any one)	[1] [1]

	(c) Expected Outcome: • Accurate classification of recyclable and non-recyclable waste • Improved recycling efficiency • Faster waste segregation • Reduced manual sorting • Reduced contamination of recyclable waste <i>(Any one)</i>	[1]
(iii)	<pre>import matplotlib.pyplot as plt sectors=["Healthcare", "Agriculture", "Manufacturing", "Education"] robots=[20, 15, 30, 10] plt.bar(sectors, robots) plt.xlabel("Sectors") plt.ylabel("Number of Robots") plt.title("Number of Robots in Different Sectors") plt.show()</pre>	[9]
Question 4		
(i)	(a) Role of gears: • Increase the torque (force) available at the gripper • Transmit motion from the motor to the robotic arm • Help lift heavier objects safely • Provide better control over movement <i>(Any one)</i> (b) Effect of changing the gear ratio: • Increasing the gear ratio increases torque (force) but decreases speed • Decreasing the gear ratio increases speed but decreases torque (force)	[1+2]
(ii)	Cyber Threat: • Phishing attack Precautions: • Do not click unknown links • Verify sender's email address • Do not share login credentials	[3]

	• Enable multi-factor authentication • Report suspicious emails • Check URL before entering credentials (Any two)	
(iii)	<pre>str="Hardwork pays" print(str[3:10]) str1=str.upper() str1.endswith('S') str2=str1.replace('Hardwork','Earnest work') print(str2) str3='OFF' str2.join(str3)</pre>	[9]
Question 5		
(i)	• The robot receives input from sensors to detect the blocked route or obstacle. • The controller/AI system processes the sensor data and analyses possible alternative routes. • The robot selects a safe alternate path (or stops if no safe route is available) and continues the delivery.	[3]
(ii)	Factors that influence the accuracy of a Machine Learning Model: • Quality of the training data. • Quantity (size) of the training dataset. • Correct labelling of the data. • Diversity of the training data. • Data cleaning before training. • Appropriate selection of the Machine Learning algorithm. • Proper training and validation/testing of the model. (Any three)	[3]
(iii)	(a) Role of Sensors (Any three) • Detect environmental changes. • Collect input data.	[3]

	• Measure physical parameters. • Send information to the controller. (b) Role of Controller (<i>Any three</i>) • Receives sensor data. • Processes information. • Makes decisions. • Sends commands to actuators. (c) Role of Actuators (<i>Any three</i>) • Convert electrical signals into movement. • Perform physical actions. • Move robot parts. • Execute controller commands. <pre>graph LR; A["Sensor (Measure process variable)"] --> B["Controller (Decision Making)"]; B --> C["Actuator (Takes action to control)"]</pre>	[3] [3]										
Question 6												
(i)	<table><thead><tr><th>Machine Intelligence</th><th>Traditional Programs</th></tr></thead><tbody><tr><td>Learns from data</td><td>Uses fixed instructions</td></tr><tr><td>Improves with experience</td><td>Does not improve automatically</td></tr><tr><td>Can recognise patterns</td><td>Follows predefined rules</td></tr><tr><td>Makes predictions</td><td>Produces fixed outputs</td></tr></tbody></table> (Any three differences)	Machine Intelligence	Traditional Programs	Learns from data	Uses fixed instructions	Improves with experience	Does not improve automatically	Can recognise patterns	Follows predefined rules	Makes predictions	Produces fixed outputs	[3]
Machine Intelligence	Traditional Programs											
Learns from data	Uses fixed instructions											
Improves with experience	Does not improve automatically											
Can recognise patterns	Follows predefined rules											
Makes predictions	Produces fixed outputs											
(ii)	Importance of data cleaning: • Removes incorrect or inaccurate data. • Eliminates duplicate records. • Handles missing or incomplete data. • Reduces noise and inconsistencies in the dataset. • Improves the accuracy of the Machine Learning model. • Reduces bias and improves the reliability of predictions. • Improves the efficiency of model training. (Any three)	[3]										

(iii)	(a) Ways Tinkercad can help in designing the waste segregation system: • It models physical bins. • Simulates sorting circuits. • Writes automation code. (b) Revolute joint is used for segregating wet waste and dry waste. It allows rotation around a single axis. (c) The model should be visualised before it is used as it: • Verifies the accuracy of the model. • Identifies errors in design. • Confirms that the model meets the required performance. • Improves reliability before deployment. <i>(Any three)</i>	[3] [3] [3]
Question 7		
(i)	Features of the robot: • Performs repetitive tasks with high accuracy. • Produces consistent and uniform decoration. • Operates continuously with minimal fatigue. • Reduces human error. • Can be programmed for different decoration patterns. • Increases productivity and efficiency. <i>(Any three)</i>	[3]
(ii)	Advantages of using robots in modern manufacturing industries: • Increases production efficiency. • Improves precision and accuracy. • Reduces human error. • Can operate continuously without fatigue. • Increases workplace safety by performing hazardous tasks. • Improves product quality and consistency. • Reduces production time. • Handles repetitive tasks efficiently. • Reduces labour costs in the long run. • Increases productivity. <i>(Any three)</i>	[3]

(iii)	(a) Machine learning can help the robot improve its performance: • Learns from previous data and experiences. • Improves the accuracy of its decisions. • Recognises patterns more effectively over time. • Adapts to new situations through training. • Continuously improves performance as more data becomes available <i>(Any three)</i> (b) Cybersecurity risks: • Unauthorised access • Malware attack • Data theft • Network hacking • Ransomware attack. <i>(Any two)</i> Preventive measures: • Strong authentication • Data encryption • Regular software updates • Firewall protection • Secure network access <i>(Any one)</i> (c) To identify the correct medicine for each patient: • AI analyses patient information and prescription details. • Compares medicine labels/barcodes with prescription data. • Identifies the correct medicine using trained models. • Reduces the chances of medication errors. • Ensures accurate and safe medicine dispensing. <i>(Any three)</i>	[3] [3] [3]
Question 8		
(i)	Benefits of using robotics and AI in agriculture: • Increases crop yield. • Reduces labour requirements.	[3]

	• Enables precision farming. • Optimises the use of water and fertilisers. • Detects crop diseases at an early stage. • Improves productivity and efficiency <i>(Any three)</i>	
(ii)	Type of data required: • Images of products on shelves. • Labelled images of correctly and incorrectly placed products. • Product barcode data. • Shelf inventory data. <i>(Any one)</i> Factor that improves model accuracy: • High-quality training data • Correctly labelled data • Large and diverse dataset • Data cleaning before training • Appropriate Machine Learning algorithm <i>(Any one)</i> Expected Outcome: • Accurate identification of misplaced products • Faster shelf management • Improved inventory accuracy • Reduced manual checking • Better customer experience <i>(Any one)</i>	[3]
(iii)	<pre> t=(50, 60, 70, 80, 90) l=list(t) l.sort(reverse=True) l.remove(80) print(l) l.sort() ft=tuple(l) print(ft) </pre>	[9]