

# REHEARSAL TEST SOLUTIONS 2025-26

## CLASS X

### Robotics and Artificial Intelligence

SXIP

Maximum Marks: 100

Time Allowed: Two Hours

#### SECTION A

[**1 × 20 = 20 marks**]

#### Question 1: Multiple Choice Questions

- I. Which of the following is an example of a domestic service robot?

**Answer**

**Answer: (a) Vacuum cleaning robot**

*Explanation:* Domestic service robots are designed to assist with household tasks. Vacuum cleaning robots (like Roomba) are specifically designed for home use to automate floor cleaning.

- II. A robot that follows a pre-defined magnetic strip on the floor is an example of:

**Answer**

**Answer: (b) Automated robot**

*Explanation:* Automated robots follow predetermined paths and rules without making independent decisions. A robot following a magnetic strip operates on fixed programming without adapting to changes.

- III. Which of the following sensors is used for distance measurement?

**Answer**

**Answer: (b) Ultrasonic sensor**

*Explanation:* Ultrasonic sensors use sound waves to measure distance by calculating the time taken for the echo to return. They are commonly used in robotics for obstacle detection and distance measurement.

IV. The process of converting electrical energy into mechanical movement is done by:

**Answer****Answer: (c) Actuator**

*Explanation:* Actuators are components that convert electrical signals into physical motion. Examples include motors, servos, and pneumatic cylinders.

V. Which Python function returns the position of a substring?

**Answer****Answer: (c) find()**

*Explanation:* The `find()` method returns the index of the first occurrence of a substring. If not found, it returns -1.

VI. Which of the following is a feature of AI-enabled smart home systems?

**Answer****Answer: (b) Voice-based automation**

*Explanation:* AI-enabled smart homes use natural language processing (NLP) to enable voice commands through assistants like Alexa, Google Assistant, or Siri.

VII. A gyroscope sensor measures:

**Answer****Answer: (b) Angular velocity**

*Explanation:* A gyroscope measures the rate of rotation or angular velocity around an axis. It helps robots maintain orientation and balance.

VIII. A robot's controller primarily performs:

**Answer****Answer: (c) Data processing**

*Explanation:* The controller is the "brain" of the robot that processes sensor data, makes decisions, and sends commands to actuators.

IX. Which Python collection type is unordered, mutable, and contains no duplicates?

**Answer****Answer: (b) Set**

*Explanation:* A set is an unordered collection that automatically removes duplicates. It is mutable (can be modified) unlike tuples.

X. Data collected from experiments, sensors, or surveys is called:

**Answer**

**Answer: (a) Raw data**

*Explanation:* Raw data is unprocessed data collected directly from sources. It needs to be cleaned and processed to become information.

XI. Which of the following is a linear actuator?

**Answer**

**Answer: (c) Hydraulic piston**

*Explanation:* Linear actuators produce motion in a straight line. Hydraulic pistons extend and retract linearly, while motors produce rotational motion.

XII. A robot using camera vision to identify objects is applying:

**Answer**

**Answer: (b) Computer vision**

*Explanation:* Computer vision enables machines to interpret and understand visual information from cameras, allowing object recognition and scene understanding.

XIII. Which string method converts a string to lowercase?

**Answer**

**Answer: (b) lower()**

*Explanation:* The `lower()` method converts all uppercase characters in a string to lowercase. Example: "HELLO".`lower()` returns "hello".

XIV. The block in a control system that sends correction signals is the:

**Answer**

**Answer: (c) Controller**

*Explanation:* The controller compares the desired setpoint with actual feedback and generates correction signals to reduce error.

XV. Which of the following is an example of structured data?

**Answer**

**Answer: (b) Excel table**

*Explanation:* Structured data is organized in a predefined format with rows and columns, like databases and spreadsheets.

XVI. A robot that performs repetitive welding is an example of a:

**Answer****Answer: (b) Industrial robot**

*Explanation:* Industrial robots are designed for manufacturing tasks like welding, assembly, and painting in factories.

XVII. The expression "AI".islower() returns:

**Answer****Answer: (b) False**

*Explanation:* The `islower()` method returns True only if all alphabetic characters are lowercase. Since "AI" contains uppercase letters, it returns False.

XVIII. The process of grouping similar data points without labels is known as:

**Answer****Answer: (c) Unsupervised learning**

*Explanation:* Unsupervised learning finds patterns in unlabeled data through techniques like clustering and dimensionality reduction.

XIX. Which sensor detects touch or pressure?

**Answer****Answer: (a) Force-sensitive resistor**

*Explanation:* Force-sensitive resistors (FSRs) change resistance based on applied pressure, enabling touch detection in robotics.

XX. A robot that moves using wheels is called a:

**Answer****Answer: (c) Wheeled mobile robot**

*Explanation:* Wheeled mobile robots use wheels for locomotion, offering speed and efficiency on flat surfaces.

## SECTION B

[ $2 \times 10 = 20$  marks]

### Question 2: Short Answer Questions

I. Differentiate between supervised and unsupervised learning.

#### Answer

**Supervised Learning:** Uses labeled data where the model learns the mapping from input to known output. The algorithm is trained with examples that have correct answers.

**Example:** Training a model with images labeled as "cat" or "dog" to classify new images.

**Unsupervised Learning:** Uses unlabeled data to discover hidden patterns, groupings, or structures without predefined categories.

**Example:** Clustering customers based on purchasing behavior without pre-labeled categories.

II. Mention any two characteristics of cobots.

#### Answer

Two key characteristics of collaborative robots (cobots):

- (a) **Safe Human Interaction:** Cobots are designed to work safely alongside humans in shared workspaces without protective barriers. They have built-in sensors and force-limiting features.
- (b) **Easy Programming:** Cobots typically feature intuitive programming interfaces, often including "lead-through" teaching where operators physically guide the robot to learn movements.

III. Differentiate between automated and autonomous systems (one point).

#### Answer

##### Key Difference:

**Automated Systems:** Follow a fixed, pre-programmed sequence of operations for repetitive tasks without adapting to environmental changes.

**Autonomous Systems:** Use sensors, AI, and decision-making algorithms to independently adapt to dynamic environments and make real-time decisions without human intervention.

*Example:* A washing machine (automated) vs. a self-driving car (autonomous).

**IV. Define Data and Information.****Answer**

**Data:** Raw, unprocessed facts, figures, symbols, or observations collected from various sources. Data lacks context and meaning on its own.

*Example:* 25, 30, 28, 32 (just numbers)

**Information:** Processed, organized, and meaningful data that provides context and is useful for decision-making.

*Example:* "The temperature over 4 days was 25°C, 30°C, 28°C, 32°C, showing an increasing trend."

**V. List three ethical issues related to cybersecurity.****Answer**

Three major ethical issues in cybersecurity:

- (a) **Privacy Violations:** Unauthorized collection, storage, or sharing of personal information without consent, leading to privacy breaches.
- (b) **Unauthorized Access (Hacking):** Illegal intrusion into computer systems, networks, or accounts, compromising data security and integrity.
- (c) **Data Misuse and Surveillance:** Unethical use of personal data for surveillance, manipulation, or discrimination without user knowledge or consent.

**VI. Write the output of the following code:**

```
1 text = "Python Programming"
2 print(text [::2])
```

**Answer**

**Output:** Pto rgamn

*Explanation:* The slice [::2] starts from index 0 and takes every 2nd character:

Position 0: P, Position 2: t, Position 4: h, Position 6: o, Position 8: (space), Position 10: r, Position 12: g, Position 14: a, Position 16: m, Position 18: n

**Result:** "Pto rgamn"

VII. What technology enables smart home robots to communicate with other devices? Explain.

### Answer

#### Internet of Things (IoT)

IoT enables smart home robots to communicate with other devices through interconnected networks. It allows devices to:

- **Connect:** Link to a common network (Wi-Fi, Bluetooth, Zigbee) to establish communication channels.
- **Exchange Data:** Share sensor data, commands, and status information in real-time.
- **Coordinate Actions:** Work together to perform automated tasks (e.g., robot vacuum starting when motion sensors detect no one home).

*Example:* A smart thermostat communicating with a robot to adjust room temperature based on occupancy.

VIII. State any two differences between internal and external sensors.

### Answer

Internal Sensors	External Sensors
Monitor the robot's own internal state and conditions	Gather information from the external environment
<b>Examples:</b> Battery voltage sensor, motor encoder, temperature sensor (for motor), gyroscope	<b>Examples:</b> Ultrasonic sensor (distance), camera, LDR (light), infrared sensor

IX. Write a Python program to create a list of 5 integers and print the first and fourth elements.

### Answer

```

1 # Create a list of 5 integers
2 numbers = [10, 20, 30, 40, 50]
3
4 # Print first element (index 0)
5 print("First element:", numbers[0])
6
7 # Print fourth element (index 3)
8 print("Fourth element:", numbers[3])

```

#### Output:

First element: 10  
Fourth element: 40

X. Explain with an example how the replace() function works in strings.

### Answer

#### **The replace() Function:**

The `replace()` method substitutes all occurrences of a specified substring with a new substring in a string.

**Syntax:** `string.replace(old, new)`

- `old`: substring to be replaced
- `new`: substring to replace with

#### **Example:**

```

1 text = "Hello World"
2 new_text = text.replace("World", "AI")
3 print(new_text) # Output: Hello AI
4
5 # Multiple replacements
6 sentence = "I love Python. Python is great."
7 result = sentence.replace("Python", "Robotics")
8 print(result) # Output: I love Robotics. Robotics is
                 great.

```

*Note:* The original string remains unchanged as strings are immutable in Python.

## SECTION C

[ $15 \times 4 = 60$  marks]

### Question 3

(a) Explain any three advantages of using robots in smart homes. [3]

### Answer

Three major advantages of robots in smart homes:

#### **1. Increased Convenience and Time-Saving:**

Smart home robots automate routine tasks like vacuuming, mopping, lawn mowing, and pool cleaning. This saves significant time for homeowners.

#### **2. Enhanced Security and Safety:**

Security robots equipped with cameras, motion sensors, and AI can patrol homes, detect intruders, and send real-time alerts to homeowners.

#### **3. Assistance for Elderly and Disabled:**

Service robots can assist elderly or disabled individuals with daily tasks such as medication reminders, fetching objects, providing companionship, and emergency alert systems.

(b) Describe the working of a robotic control system using set point, controller, actuator, and feedback. [3]

### Answer

#### **Working of a Robotic Control System:**

A robotic control system maintains desired behavior through continuous feedback:

##### **1. Set Point (Reference Input):**

The desired target value or goal the system should achieve. Example: maintaining room temperature at 22°C or positioning a robotic arm at a specific angle.

##### **2. Controller (Decision Maker):**

Compares the set point with the actual output (feedback) to calculate the error. It then generates appropriate correction signals to minimize this error. The controller uses algorithms like PID (Proportional-Integral-Derivative) control.

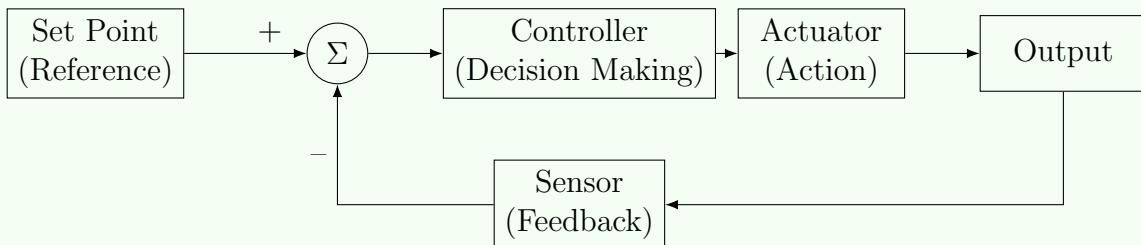
##### **3. Actuator (Action Component):**

Receives control signals from the controller and converts them into physical action (mechanical movement). Examples include motors, servos, or pneumatic cylinders that move robot joints or wheels.

##### **4. Feedback (Sensor Input):**

Sensors measure the actual output or state of the system and send this information back to the controller. This creates a closed-loop system that continuously adjusts to maintain the desired behavior.

#### **Process Flow:**



*Example:* A line-following robot: Set point is "stay on line," sensors detect line position (feedback), controller calculates correction, and motors (actuators) adjust wheel speeds.

(c) Write the name of the Python operators: +, \*\*, =, !=, //, and, not in. [3]

### Answer

Operator	Name	Type
+	Addition operator	Arithmetic operator
**	Exponentiation operator	Arithmetic operator
=	Assignment operator	Assignment operator
!=	Not equal to operator	Comparison operator
//	Floor division operator	Arithmetic operator
and	Logical AND operator	Logical operator
not in	Membership operator (negation)	Membership operator

### Examples:

```

1 result = 5 + 3           # Addition: 8
2 power = 2 ** 3          # Exponentiation: 8
3 x = 10                  # Assignment
4 check = (5 != 3)         # Not equal: True
5 quotient = 17 // 5       # Floor division: 3
6 logic = True and False   # Logical AND: False
7 test = 'a' not in 'xyz'  # Membership: True

```

(d) Write a Python program to check whether a number is prime. [6]

### Answer

```

1 def is_prime(n):
2     if n < 2:
3         return "NOT a prime number"
4     for i in range(2, int(n**0.5) + 1):
5         if n % i == 0:
6             return "NOT a prime number"
7     return "a prime number"
8
9 n = int(input("Enter a number: "))
10 print(f"{n} is {is_prime(n)}.")

```

### Sample Output:

Enter a number: 17  
17 is a prime number.

### Logic Explanation:

Numbers less than 2 are not prime → Check if number is divisible by any number from 2 to  $\sqrt{n}$  → If divisible, it's not prime; otherwise, it's prime → Optimization: Only check up to square root as factors come in pairs.

### Alternative method (without function)

```

1 n = int(input("Enter a number: "))
2
3 if n < 2:
4     print(f"{n} is not a prime number.")
5 else:
6     is_prime_flag = True
7     for i in range(2, int(n ** 0.5) + 1):
8         if n % i == 0:
9             is_prime_flag = False
10            break
11
12 if is_prime_flag:
13     print(f"{n} is a prime number.")
14 else:
15     print(f"{n} is not a prime number.")

```

## Question 4

(a) Explain subjective and objective decision-making with one example. [3]

### Answer

#### **Objective Decision-Making:**

Based on measurable facts, data, and logical analysis without personal feelings or biases. Decisions are consistent and can be verified.

**Example:** A robot stopping when its ultrasonic sensor detects an obstacle at exactly 5 cm distance. The decision is based on precise sensor data (objective measurement).

#### **Subjective Decision-Making:**

Based on personal opinions, feelings, experiences, and individual perspectives. Different people may make different decisions given the same information.

**Example:** An AI recommendation system suggesting a movie because it "thinks" you will like the mood or genre based on your previous viewing patterns. The interpretation of "what you might like" involves subjective elements.

(b) Define pitch circle and pressure angle of gears. [3]

### Answer

#### **Pitch Circle:**

An imaginary circle that represents the effective diameter of a gear. When two gears mesh, their pitch circles roll against each other without slipping, transmitting motion smoothly. The pitch circle divides the gear tooth into two parts: addendum (above) and dedendum (below).

#### **Pressure Angle:**

The angle between the line of force (normal to the tooth surface at the point of contact) and the tangent to the pitch circle at that point. Standard pressure angles are 14.5°, 20°, and 25°. (higher angle = stronger teeth)

(c) Explain the role of gears in robotic motion. [3]

### Answer

Gears are crucial mechanical components that enable efficient motion and force transmission in robots:

**1. Speed Control and Torque Multiplication:**

Gears can increase or decrease rotational speed between input and output. A small gear driving a larger gear reduces speed but increases torque (mechanical advantage), essential for heavy-lifting robots. Conversely, a large gear driving a small gear increases speed.

**2. Precision and Accuracy:**

Gears ensure precise control of robotic arms, wheels, and actuators, which is essential for tasks like assembly and surgery.

**3. Direction Change:**

Gears can change the direction of rotation (clockwise to counterclockwise) and the axis of rotation (horizontal to vertical using bevel gears), enabling complex multi-directional movements.

(d) Write three differences between a robot and a cobot with examples. [3]

### Answer

Feature	Industrial Robot	Cobot
<b>Working Environment</b>	Operates in isolated cages or restricted areas separated from humans for safety.	Works alongside humans in shared workspaces without safety barriers.
<b>Programming Complexity</b>	Requires complex programming using specialized languages and extensive setup.	Easy to program with intuitive interfaces.
<b>Safety Features</b>	High-speed operations; Requires external safety systems.	Built-in sensors for human safety.
<b>Application Example</b>	Heavy automotive chassis welding in isolated production lines.	Collaborative assembly tasks like sorting small electronic components.

(e) How do assistant robots help in patient care? Give two examples. [3]

**Answer**

Assistant robots play an important role in modern healthcare by supporting patients and medical staff.

**1. Medical Assistance:**

Robots can deliver medicines, carry medical equipment, and assist nurses, reducing workload and human error.

**2. Patient Monitoring:**

Robots monitor vital signs such as heart rate and temperature and alert doctors in case of emergencies.

**Question 5**

(a) Describe how machines classify objects compared to humans. [3]

**Answer**

Humans classify objects using natural intelligence, experience, emotions, and multiple senses such as sight and touch.

Machines classify objects using artificial intelligence algorithms that analyze numerical data such as pixels, shapes, edges, and patterns. Machine learning models require large amounts of labelled data to learn and accurately classify objects.

(b) Explain any three advantages of using Tinkercad for robot simulation. [3]

**Answer****1. Cost-Effective Learning:**

Tinkercad allows students to design and test circuits virtually without purchasing physical components.

**2. Safe Environment:**

Users can experiment without risk of short circuits, component damage, or electrical hazards.

**3. Easy Accessibility:**

Being browser-based, Tinkercad can be accessed from any computer without installing software.

(c) List any three visual data representation methods with one use each. [3]

**Answer**

1. **Bar Charts:** Used for comparing discrete categories or quantities across different groups. Bars represent values with their height or length.  
*Example:* Showing monthly sales figures of different robot models.
2. **Line Graphs:** Used to display trends, changes, or continuous data over time. Points are connected with lines to show progression.  
*Example:* Tracking temperature variations recorded by a sensor throughout the day.
3. **Pie Charts:** Used to represent parts of a whole as percentages or proportions. Each slice represents a category's share of the total.  
*Example:* Showing distribution of time spent by a robot on different tasks (cleaning: 40%, surveillance: 30%, delivery: 30%).

(d) Name the five stages of the AI project framework. Describe Problem Scoping in detail. [3+3]

**Answer****Five Stages of AI Project Framework:**

Problem Scoping → Data Acquisition → Data Exploration → Modelling → Evaluation

**Problem Scoping:**

Problem scoping is the first and most important stage of an AI project. It involves clearly defining the problem that needs to be solved using the **4W framework**:

1. **WHO is facing the problem?** Identify the stakeholders affected by the problem: end-users, customers, organization, or community.
2. **WHAT is the problem?**  
Clearly define the core issue that needs solving. Be specific about symptoms, causes, and desired outcomes.
3. **WHERE is the problem occurring?**  
Specify the context, location, or environment where the problem exists.
4. **WHY is it important to solve?**  
Explain the impact, consequences, and benefits of solving this problem.

Proper problem scoping ensures correct data collection and effective AI solutions.

## Question 6

(a) Explain training data and testing data with examples. [2+2]

### Answer

**Training Data:**

Training data is the dataset used to teach an AI model patterns and relationships.

*Example:* Images of cats and dogs labelled for training an image classifier.

**Testing Data:**

Testing data is used to evaluate the model's performance on unseen data. *Example:*

New images used to test classification accuracy.

(b) What is the Turing Test? Explain the process. [5]

### Answer

The Turing Test, proposed by Alan Turing, is a method to determine whether a machine can exhibit human-like intelligence.

**Process:**

1. A human evaluator interacts with a human and a machine via text.
2. Both participants are hidden from the evaluator.
3. If the evaluator cannot reliably distinguish the machine from the human, the machine passes the test.

The test focuses on intelligent behavior rather than internal mechanisms.

(c) Write three importance of reliable data sources and three features of Kaggle. [3+3]

### Answer

**Importance of Reliable Data Sources:**

1. Improves accuracy of AI models
2. Reduces bias and errors
3. Builds trust in AI systems

**Features of Kaggle:**

1. Large collection of public datasets
2. AI and data science competitions
3. Online notebooks for coding

## Question 7

(a) What is a Python module? Explain with one example why modules are useful. [3]

### Answer

A Python module is a file containing reusable functions, variables, and classes.

Modules help in organizing code, reducing repetition, and improving readability.

*Example:* The `math` module provides mathematical functions like `sqrt()` and `pi`.

(b) What is the difference between a package and a library? Give one example of each. [3]

### Answer

A **package** is a collection of related modules organized in folders. *Example:* `xml`

A **library** is a larger collection of packages and modules designed for specific tasks.

*Example:* `Matplotlib`

(c) Explain the use of NumPy, Pandas, and Matplotlib. [3]

### Answer

1. **NumPy:** Used for numerical computations and arrays

2. **Pandas:** Used for data manipulation and analysis

3. **Matplotlib:** Used for data visualization and plotting graphs

(d) Write a Python program that imports NumPy, creates an array [5, 10, 15, 20, 25], prints squares of elements, and plots a line graph using Matplotlib. [6]

### Answer

```
1 import numpy as np
2 import matplotlib.pyplot as plt
3
4 arr = np.array([5, 10, 15, 20, 25])
5 squares = arr ** 2
6
7 print("Squares:", squares)
8
9 plt.plot(arr, squares, marker='o')
10 plt.xlabel("Numbers")
11 plt.ylabel("Squares")
12 plt.title("Number vs Square")
13 plt.show()
```

## Question 8

(a) List any three differences between lists and tuples. [3]

### Answer

Feature	List	Tuple
<b>Mutability</b>	<b>Mutable:</b> Elements can be added, removed, or modified after creation.	<b>Immutable:</b> Once created, elements cannot be changed, added, or removed.
<b>Syntax</b>	Defined using square brackets []	Defined using parentheses ()
<b>Performance</b>	Slower due to dynamic size and modification overhead.	Faster iteration and access due to fixed size and immutability.
<b>Memory</b>	Requires more memory due to dynamic allocation.	Requires less memory due to fixed size.

(b) Explain any three string in-built functions with examples. [3]

### Answer

1. **upper():** Converts string to uppercase  
Example: "ai".upper() → "AI"
2. **strip():** Removes leading and trailing spaces  
Example: " hi ".strip() → "hi"
3. **isdigit():** Checks if string contains only digits  
Example: "123".isdigit() → True

(c) Write the output of the following code: [3]

```

1 my_list = [4, 12, 7, 12, 9]
2 my_list.insert(2, 15)
3 my_list.remove(12)
4 print(my_list[1:5])

```

**Answer**

**Step-by-Step Execution:** Initial state:

```
my_list = [4, 12, 7, 12, 9]
Index:      0   1   2   3   4
```

**Step 1:** The `insert()` method inserts value 15 at index 2:

```
my_list = [4, 12, 15, 7, 12, 9]
Index:      0   1   2   3   4   5
```

**Step 2:** The `remove()` method removes the **first occurrence** of 12:

```
my_list = [4, 15, 7, 12, 9]
Index:      0   1   2   3   4
```

**Step 3:** Slice from index 1 to 4 (5 is exclusive): **(FINAL OUTPUT)**

```
[15, 7, 12, 9]
```

(d) Write a Python program for list and tuple operations. [6]

**Answer**

```
1 lst = ["AI", "Robotics", "Python", "Sensors"]
2 tup = tuple(lst)
3
4 print("First:", tup[0])
5 print("Last:", tup[-1])
6
7 lst = list(tup)
8 lst.append("Actuators")
9
10 result = " - ".join(lst)
11 print(result)
```