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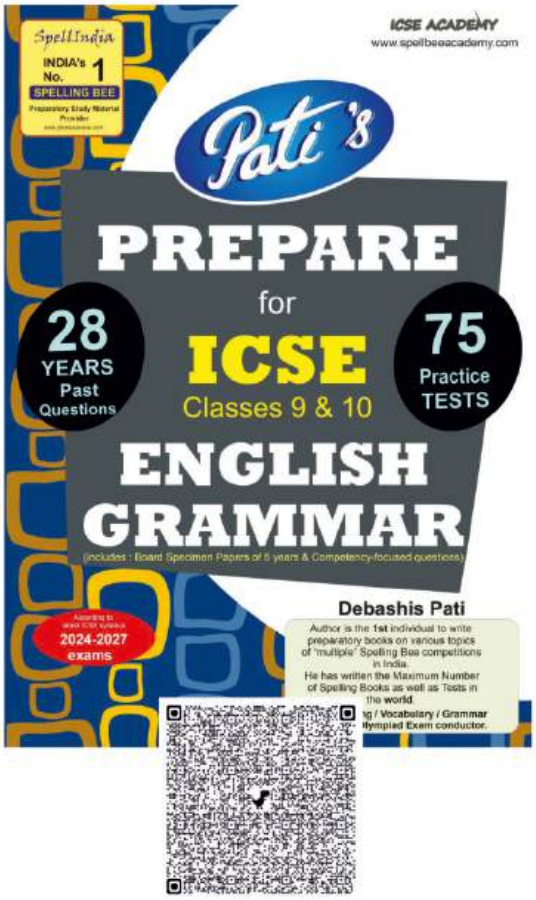

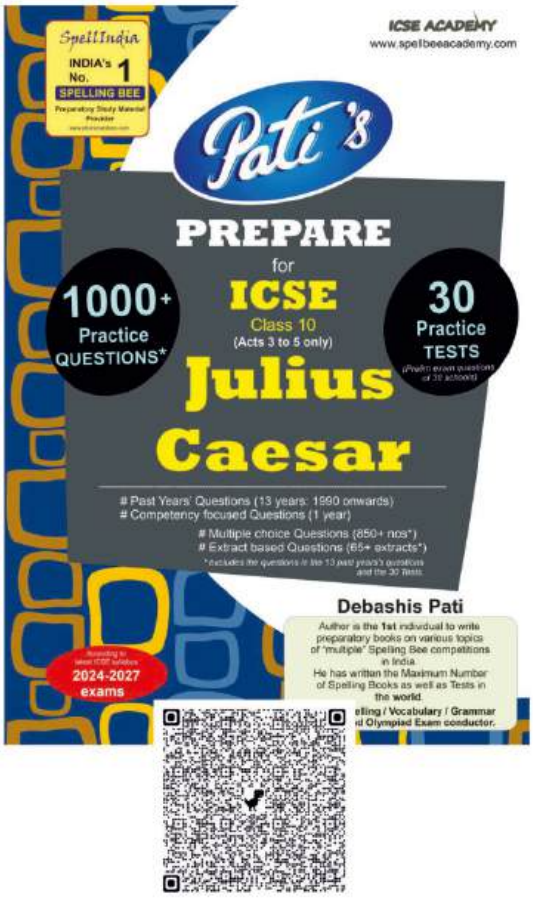

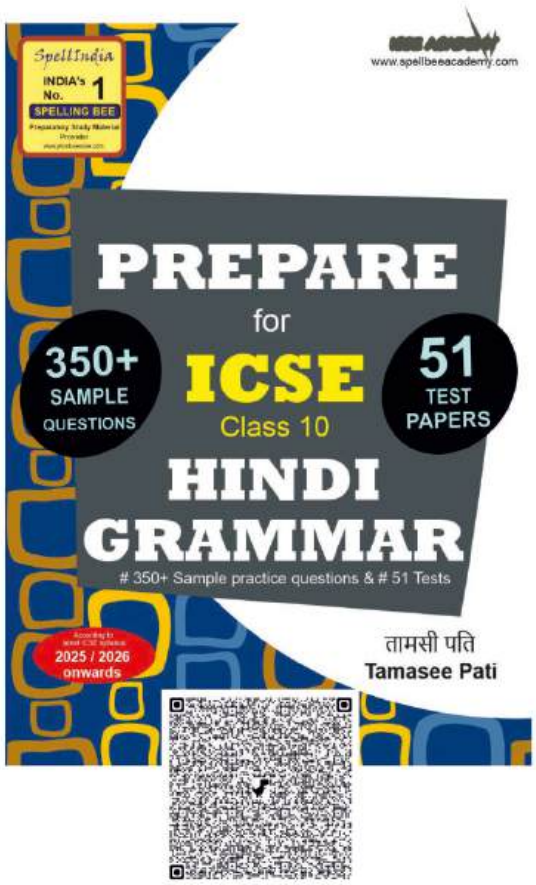

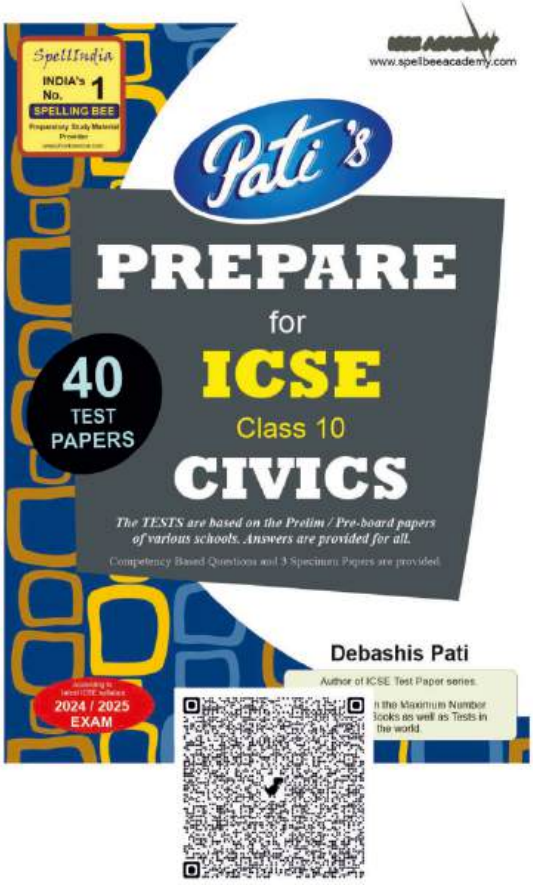

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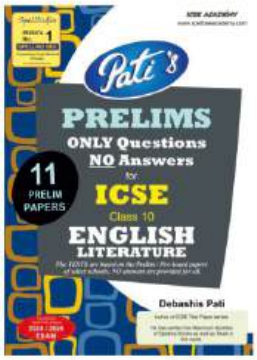

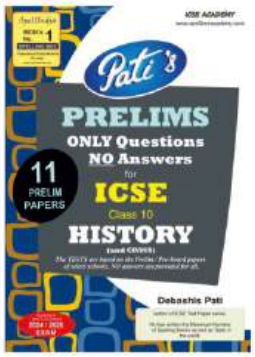

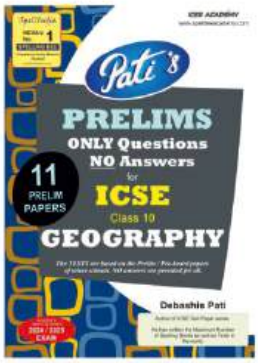

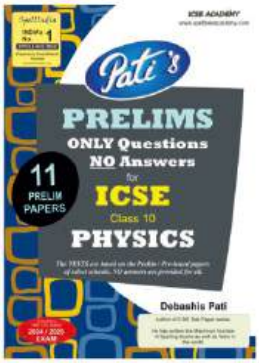

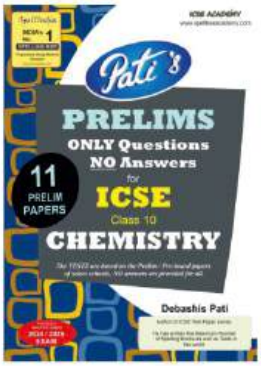

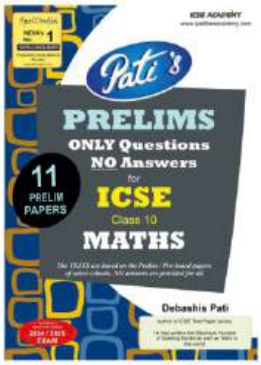

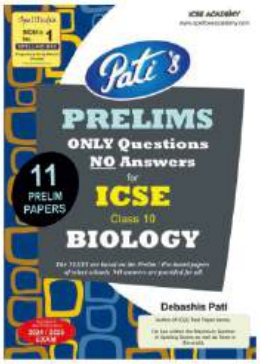

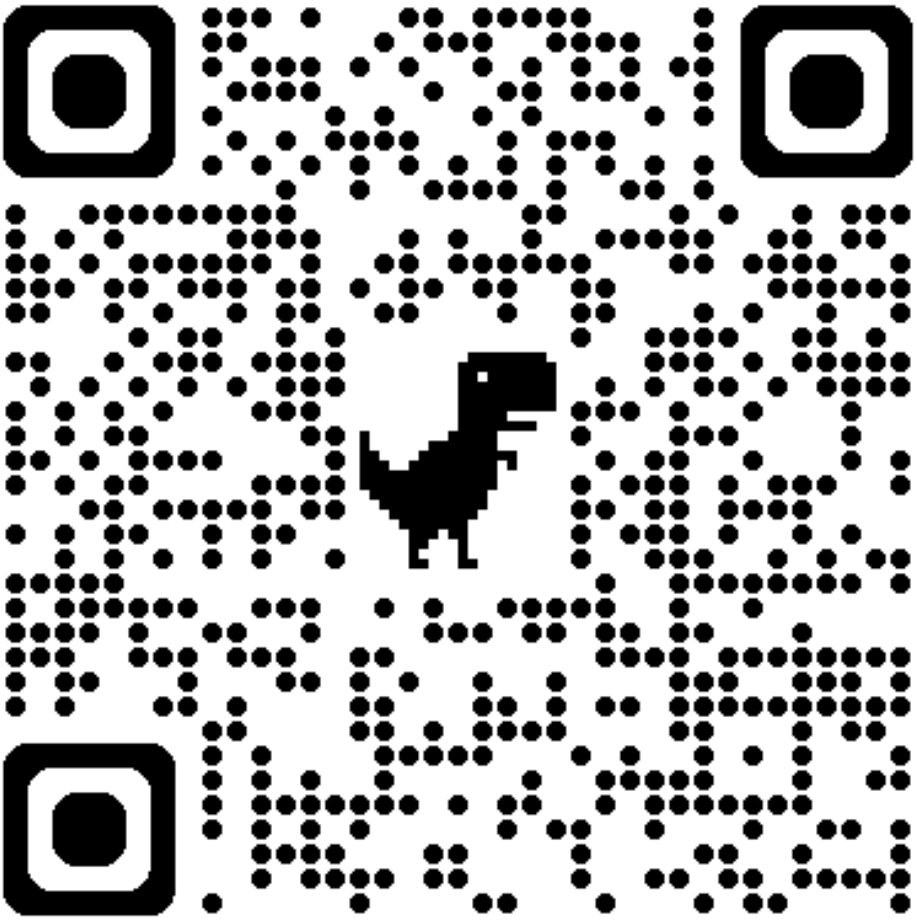

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ICSE 2025 EXAMINATION

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.

SECTION A (40 Marks)

(Attempt all questions from this Section.)

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) Select the field in which the following robots are used.

(a) Agriculture

(b) Warehouse

(c) Electric Car

(d) Entertainment

(ii) Which of the following is an example of probabilistic computing?

(a) Time tables

(b) Maps

(c) Report cards

(d) Weather forecast

(iii) Which of the following statements about cobots is true?

(a) Cobots eliminate the need for human presence

(b) Cobots work collaboratively with humans

(c) Cobots are used only in educational settings

(d) Cobots are outdated technology

(iv) Tinkercad can be used to design and simulate the motion of a simple robotic system, such as a wheeled mobile robot.

(a) True

(b) False

(v) Consider the following block diagram of a control system in a robot:

[Input] → [Controller] → [Robot] → [Feedback]

Which component of this system is responsible for making decisions based on sensor data?

(a) Input

(b) Robot

(c) Controller

(d) Feedback

(vi) What is the function of actuators in a robotic system?

(a) To process data from sensors

(b) To control the power supply to the robot

(c) To convert electrical signals into physical movement

(d) To regulate the temperature within the robot

(vii) Which of the following character is used to give a single line comment in Python?

(a) //

(b) #

(c) !

(d) /*

(viii) Camera is an example of:

(a) Pressure Sensor

(b) Vision Sensor

(c) Solar Sensor

(d) Motion Sensor

(ix) Which of the following expressions is the correct option for ab?

(a) a*b

(b) a**b

(c) a^b

(d) a^*b

(x) Which statement about single-board computers in robotics is correct?

(a) Single-board computers are only used for power supply in robotic systems.

(b) Single-board computers cannot process sensor data.

(c) Single-board computers are used to control the operations of a robotic system.

(d) Single-board computers are not suitable for use in wheeled mobile robots.

(xi) In the context of machine learning, what is the role of data?

(a) To execute pre-defined instructions.

(b) To provide examples for machine learning and predictions.

(c) To store the robot's programming code.

(d) To manage and direct the robot's movements.

(xii) The motor in a robot works as a/an:

(a) Actuator

(b) Sensor

(c) End effector

(d) Controller

(xiii) Which statement best describes the Turing Test?

(a) It measures the speed of a computer.

(b) It evaluates a machine's intelligence.

(c) It tests human memory capacity.

(d) It determines a person's IQ score.

(xiv) What is the primary goal of cybersecurity?

(a) To increase computer speed

(b) To protect data from unauthorised access

(c) To reduce software development time

(d) To enhance user interface design

(xv) **Assertion (A):** The Turing Test helps in evaluating the intelligence of a machine.

Reason (R): The Turing Test checks if a machine can exhibit human-like behavior.

(a) Both A and R are true, and R is the correct explanation of A

(b) Both A and R are true, but R is not the correct explanation of A

(c) A is true, but R is false

(d) A is false, but R is true

(xvi) What are the 4 Ws used for understanding a problem in AI project scoping?

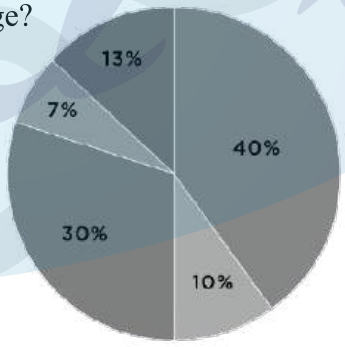
(a) Who, What, When, Where

(b) Why, When, Where, What

(c) Who, What, Where, Why

(d) Who, Where, When, Why

(xvii) What type of graph is shown in the image?



(a) Line graph

(b) Bar graph

(c) Pie chart

(d) Scatter plot

(xviii) What does the following code output?

```
string = "Hello World"
print(string[1:5])
```

(a) "Hell"

(b) "ello"

(c) "World"

(d) "Hello"

(xix) The full form of IDLE is:

(a) Integrated Development and Language Environment.

(b) Integrated Development and Learning Environment.

(c) Inline Development and Learning Environment.

(d) Inside Development and Language Environment

(xx) Which operation can be performed on both lists and tuples?

(a) Append elements

(b) Insert elements

(c) Access elements

(d) Delete elements

Question 2

Answer the following questions:

(i) What are some features of smart home robotic systems? [2]

(ii) *Cobots are becoming increasingly important in industries where human-robot collaboration can enhance productivity and safety. For example, in manufacturing, cobots can perform repetitive tasks while humans handle more complex and decision-making tasks, leading to more efficient workflows.* [2]

With reference to the above, mention two benefits of using cobots in manufacturing.

(iii) Explain the role of gears in robotic systems. [2]

(iv) Differentiate between Data and Information. [2]

(v) Outline the steps involved in machine learning. [2]

(vi) What is the Turing Test, and what role does it play in AI? [2]

(vii) What is problem scoping in the context of an AI project? [2]

(viii) What will be the output of the code given below: [2]

```
my_list = [10, 20, 30, 40, 50];
print("The number is ",my_list[-2])
```

(ix) What will be the output of the code given below: [2]

```
import numpy as np
arr = np.array([1, 2, 3, 4, 5]);
print(arr[2]);
```

(x) What will be the output of the code given below [2]

```
text = "Python Programming";
print(text[7:]);
```

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.

Each program should be written using variable description / mnemonic codes so that the logic of the program is clearly depicted.

Flowcharts and algorithms are not required.

Question 3

(i) How do assistant robots in healthcare improve patient care? [3]
Provide two specific examples.

(ii) What are the main differences between subjective decision making by humans and objective decision making by machines? [3]

(iii) Write a Python program to plot a bar chart using the Matplotlib library. Your program should: [9]

1. Import the necessary libraries.
2. Create a list of categories and their corresponding values.
3. Plot a bar chart with appropriate labels and a title.

Question 4

(i) Explain the key differences between traditional industrial robots and cobots. [3]

Why are cobots considered more suitable for collaborative tasks?

(ii) Describe the steps involved in a machine learning project using the example of fruit sorting. [3]

(iii) Create a user defined function isPrime ( ) to accept a number and returns True if number is prime otherwise False. (A number is said to be prime if it is only divisible by itself and 1) [9]

Question 5

(i) Define the role of sensors in robotics. [3]

Differentiate between internal and external sensors with examples.

(ii) List three ethical issues related to cybersecurity. [3]

(iii) A library charges fine according to the number of days a book returned late, according to the following criteria. [9]

Days	**Fine per day**
First 10 days	Rs. 1
Next 10 days	Rs. 2.5
Beyond 20 days	Rs. 5

Write a program to enter the number of days a book was returned late and print the fine to be paid.

Question 6

(i) Explain the use of Tinkercad in designing robotic components. [3]

What are the advantages of visualising motion using Tinkercad?

(ii) Explain how the phenomenon of hacking can lead to data theft and what measures can be implemented to prevent it. [3]

(iii) Write a Python program that performs the following operations on a list of integers: [9]

1. Create a list of integers: [10, 20, 30, 40, 50].
2. Append the integer 60 to the list.
3. Insert the integer 25 at index 2.
4. Sort the list in ascending order.
5. Search for the integer 30 in the list and print its index.
6. Print the final list.

Question 7

(i) Explain the importance of integrating sensors, actuators, and controllers in a robotic system. [3]

(ii) Explain the importance of defining the problem statement in an AI project. How does it impact the project's success? [3]

(iii) Write a Python program that performs the following operations on a tuple: [9]

1. Create a tuple with the elements: (5, 10, 15, 20, 25).
2. Access and print the element at index 2.
3. Convert the tuple into a list.
4. Append the integer 30 to the list.
5. Convert the list back into a tuple.
6. Print the final tuple.

Question 8

(i) Describe the process of building a simple wheeled mobile robot and mention the key components involved. [3]

(ii) List and briefly describe three different ways of representing data visually. [3]

(iii) Write a Python program that performs the following operations on a string: [9]

1. Create a string with the value "Artificial Intelligence".
2. Convert the entire string to uppercase and print the result.
3. Find and print the position of the substring "Intelligence" within the string.
4. Replace the substring "Artificial" with "Machine" and print the new string.
5. Check if the string starts with "Machine" and print the result (True/False).
6. Count and print the number of occurrences of the letter 'i' in the string.

ICSE 2025 SPECIMEN

DRAFT MARKING SCHEME - ROBOTICS & ARTIFICIAL INTELLIGENCE

SECTION A (40 Marks)

Question 1			[20]
(i)	(b)	Warehouse	
(ii)	(d)	Weather forecast	
(iii)	(b)	Cobots work collaboratively with humans	
(iv)	(a)	True	
(v)	(c)	Controller	
(vi)	(c)	To convert electrical signals into physical movement	
(vii)	(b)	#	
(viii)	(b)	Vision Sensor	
(ix)	(a)	a*b	
(x)	(c)	Single-board computers are used to control the operations of a robotic system.	
(xi)	(b)	To provide examples for machine learning and predictions.	
(xii)	(a)	Actuator	
(xiii)	(b)	It evaluates a machine's intelligence.	
(xiv)	(b)	To protect data from unauthorised access	
(xv)	(a)	Both A and R are true, and R is the correct explanation of A	
(xvi)	(c)	Who, What, Where, Why	
(xvii)	(c)	Pie Chart	
(xviii)	(b)	"ello"	
(xix)	(b)	Integrated Development and Learning Environment.	
(xx)	(c)	Access elements	

Question 2		
(i)	Features of smart home robotic systems: • Automated lighting, temperature, and appliances • Voice/gesture control • Security monitoring (CCTV, smart locks) • Energy efficiency (auto shut-off) • Remote access via smartphone/IoT *(any two)*	[2]
(ii)	Benefits of cobots in manufacturing: Increased productivity Enhanced worker safety Reduced human fatigue Cost efficiency in repetitive tasks Flexibility in operations *(any two)*	[2]
(iii)	Role of gears: Transmit motion between parts Change speed or torque Change direction of motion Provide mechanical advantage *(any two)*	[2]
(iv)	Data vs Information: **Data:** It refers to raw, unorganised facts and figures that by themselves do not carry any specific meaning. It can be in the form of numbers, characters, symbols, or even images and sounds. Data is context-free and cannot be directly used for decision-making until it is processed. For example, a collection of numbers like *23, 45, 67, 89* is just data without any context. (Key concepts: Raw facts, figures, symbols - e.g., numbers, readings). **Information:** Information, on the other hand, is the processed and organized form of data which gives it meaning and usefulness. When data is analyzed and interpreted in a context, it becomes information. Information is meaningful, helps in understanding situations, and supports decision-making. For example, if the given numbers represent student marks, then calculating the *average marks as 56* gives information. (Key concepts: Processed, organized data with meaning.)	[2]

(v)	Steps in Machine Learning: 1. Problem definition 2. Data collection 3. Data preprocessing 4. Model selection 5. Training the model 6. Evaluation and validation 7. Deployment and monitoring	[2]
(vi)	The Turing Test is a measure of a machine's ability to exhibit intelligent behavior indistinguishable from that of a human. Role: It assesses whether a machine can simulate human-like responses in natural language conversations.	[2]
(vii)	Problem scoping involves understanding the problem, identifying factors influencing it, and defining project goals. This includes addressing the 4 W's (Who, What, Where, Why) and formulating a clear problem statement.	[2]
(viii)	The number is 40	[2]
(ix)	3	[2]
(x)	Programming	[2]
Question 3		
(i)	Assistant robots in healthcare improve patient care by performing routine tasks, allowing healthcare professionals to focus on more critical aspects of patient care, and providing support for patients with limited mobility. Examples: *(any two)* 1. **Medication Delivery:** Robots can deliver medications to patients, ensuring timely administration and reducing the workload on nursing staff. 2. **Patient Monitoring:** Robots equipped with sensors can monitor vital signs and alert medical staff if abnormalities are detected, providing continuous patient monitoring. 3. **Surgery assistance:** (e.g., da Vinci robot): Increases precision, enables minimally invasive surgery (e.g., da Vinci surgical system).	[3]

	4. **Elderly/disabled care robots**: Assist with mobility, companionship, reminders for medication.	
(ii)	Subjective decision making by humans involves personal judgment, emotions, intuition and experiences. It can vary widely between individuals. Objective decision making by machines relies on data and algorithms, leading to consistent and repeatable outcomes based on the same input data. It lacks emotions and is purely logical	[3]

(iii)	import matplotlib.pyplot as plt
	# Create a list of categories and their corresponding values
	categories = ['A', 'B', 'C', 'D', 'E']
	values = [5, 7, 3, 8, 6]
	# Plot a bar chart
	plt.bar(categories, values, color='blue')
	# Add labels and a title
	plt.xlabel('Categories')
	plt.ylabel('Values')
	plt.title('Bar Chart Example')
	# Display the bar chart
	plt.show()
		[9]

SECTION B (60 Marks) **Question 4**		
(i)	Differences: 1. **Traditional Industrial Robots:** These robots operate in isolated environments and are typically used for repetitive, high-speed tasks in manufacturing. They require safety barriers to prevent human interaction during operation. They can perform heavy-duty tasks at fenced-off areas. 2. **Cobots (Collaborative Robots)**: Cobots are designed to work alongside humans without safety barriers. They are equipped with advanced sensors and safety features to detect and respond to human presence. They are lightweight, flexible and easy to reprogram. **Suitability for Collaborative Tasks**: Cobots are more suitable for collaborative tasks because they can safely interact with humans, enhancing productivity and flexibility in the workplace. Their ability to perform tasks that require human intervention makes them ideal for environments where human-robot collaboration is essential.	[3]

(ii)	1. **Data Collection**: Gather images of different fruits. 2. **Data Preparation**: Label the images and preprocess them for analysis. 3. **Feature Extraction**: Identify key features like color, shape, and size. 4. **Model Training**: Use a machine learning algorithm to train a model on the labeled data. 5. **Model Testing:** Evaluate the model's accuracy using a separate test dataset. 6. **Deployment**: Implement the trained model to sort fruits in real-time based on the identified features.	[3]

(iii)	def isPrime(num):
	if num <= 1:
	return False
	for i in range(2, int(num**0.5) + 1):
	if num % i == 0:
	return False
	return True
	Acceptable variations:
	Checking divisibility from 2 -> n–1 OR 2 -> √n.
	Early return if divisible.
	Handling special cases (n ≤ 1).
		[9]

Question 5		
(i)	**Role of Sensors in Robotics:** Sensors are crucial in robotics as they provide the necessary data for the robot to perceive its environment, make decisions, and perform tasks accurately. **Internal Sensors:** **Function**: Measure the robot's internal state. 1. **Examples**: Position sensors, velocity sensors, acceleration sensors, force sensors, gyroscope, accelerometer, motor encoder **External Sensors:** 1. **Function**: Detect external conditions and environment. 2. **Examples**: Vision sensors (cameras), tactile sensors, temperature sensors, range and proximity sensors, speech recognition sensors, ultrasonic, IR, touch sensor.	[3]

(ii)	Unauthorized use of hardware. Theft of software and intellectual property. Committing fraud using computers. Data privacy violation. Unauthorized access/hacking. Identity theft. Spreading malware/ransomware. Financial fraud. Misuse of AI in phishing/scams. *(any three)*	[3]

(iii)	days = int(input("Enter number of days late: "))
	if days <= 10:
	  fine = days * 1
	elif days <= 20:
	  fine = 10*1 + (days-10)*2.5
	else:
	  fine = 10*1 + 10*2.5 + (days-20)*5
	print("Fine to be paid:", fine)
	(Any other relevant solution)
		[9]

Question 6		
(i)	Tinkercad is an online tool that allows users to create 3D designs and simulate the assembly of robotic components. It provides a visual interface for designing various parts such as joints, gears, and mechanisms. **Advantages of Visualizing Motion Using Tinkercad:** **1.** **Interactive Learning:** Tinkercad helps in understanding the movement and interaction of designed components, providing a hands-on learning experience. **2.** **Error Detection:** It allows users to identify and rectify design flaws by simulating the motion, ensuring that the components work correctly before actual fabrication. **3.** It is very cost-effective. **4.** Students can visualize before building the project **5.** It helps in easy debugging of errors. **6.** It enables safe testing of the projects. *(Any two advantages)*	[3]

(ii)	Hacking involves unauthorized access to computer systems, often leading to data theft where sensitive information is stolen. Measures to prevent hacking include using strong passwords, implementing multi-factor authentication, regular software updates, and employing encryption to protect data.	[3]

(iii)	# Create a list of integers
	numbers = [10, 20, 30, 40,50]
	# Append the integer 60 to the list
	numbers.append(60)
	# Insert the integer 25 at index 2
	numbers.insert(2, 25)
	# Sort the list in ascending order
	numbers.sort()
	# Search for the integer 30 in the list and print its index
	index_of_30 = numbers.index(30)
	print("Index of 30:", index_of_30)
	# Print the final list
	print("Final list:", numbers)
		[9]

Question 7		
(i)	Integrating sensors, actuators, and controllers is crucial in a robotic system as it allows the robot to perceive its environment, make decisions, and perform actions. Sensors provide data about the surroundings by gathering input from the environment, actuators execute movements and controllers process the sensor data to control the actuators accordingly. This integration ensures that the robot can operate autonomously and efficiently.	[3]
(ii)	Defining the problem statement is crucial because it sets the direction for the entire project. It clarifies the issue to be addressed, aligns the project team, and helps in identifying the specific objectives and goals. A well-defined problem statement ensures that the project stays focused and relevant, ultimately increasing the chances of success by solving the right problem effectively.	[3]

(iii)	# Create a tuple with the elements
	numbers_tuple = (5, 10, 15, 20, 25)
	# Access and print the element at index 2
	print("Element at index 2:", numbers_tuple[2])
		[9]

	# Convert the tuple into a list
	numbers_list = list(numbers_tuple)
	# Append the integer 30 to the list
	numbers_list.append(30)
	# Convert the list back into a tuple
	final_tuple = tuple(numbers_list)
	# Print the final tuple
	print("Final tuple:", final_tuple)	

Question 8		
(i)	**Process**: Design the Frame: Construct a sturdy base to house all components. Assemble chassis, controller. Install Wheels and Motors: Attach wheels and connect them to motors for mobility. Integrate Sensors: Add sensors for navigation and obstacle detection. Add Controller: Incorporate a microcontroller to process sensor data and control motor functions. Program the Robot: Write and upload code to define the robot's behavior. **Key Components:** Frame or chassis Wheels and DC motors Sensors (e.g., ultrasonic sensors) Microcontroller (e.g., Arduino or Microbit or raspberry pie) Battery and power supply Connecting wires and hardware tools	[3]
(ii)	**Bar Graphs**: Display categorical data with rectangular bars representing the frequency or value of each category. **Line Graphs:** Show trends over time by connecting data points with a continuous line, useful for time series data. **Pie Charts:** Represent data as slices of a circular pie, where each slice corresponds to the proportion of each category within the whole dataset. **Histogram**: Frequency distribution. **Scatter plot:** Relationship between variables. *(any three)*	[3]

(iii)	# Create a string with the value "Artificial Intelligence"
	original_string = "Artificial Intelligence"
	# Convert the entire string to uppercase and print the result
	uppercase_string = original_string.upper()
	print("Uppercase string:", uppercase_string)
	# Find and print the position of the substring "Intelligence" within the string
	position_intelligence = original_string.find("Intelligence")
	print("Position of 'Intelligence':", position_intelligence)
	# Replace the substring "Artificial" with "Machine" and print the new string
	new_string = original_string.replace("Artificial", "Machine")
	print("New string:", new_string)
	# Check if the string starts with "Machine" and print the result (True/False)
	starts_with_machine = new_string.startswith("Machine")
	print("Starts with 'Machine':", starts_with_machine)
	# Count and print the number of occurrences of the letter 'i' in the string
	count_i = original_string.count('i')
	print("Number of occurrences of 'i':", count_i)
		[9]

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