FEDERAL BOARD OF INTERMEDIATE AND SECONDARY EDUCATION
H-8/4, ISLAMABAD

ASSESSMENT MANUAL FOR THEORY & PRACTICAL OF ARTIFICIAL INTELLIGENCE & ROBOTICS HSSC-I (SCHEME OF STUDIES 2024)

FEDERAL BOARD OF INTERMEDIATE AND SECONDARY EDUCATION
H-8/4, ISLAMABAD

Artificial Intelligence & Robotics - Scheme of Studies 2024

Theory & Practical Paper Assessment (Total Marks: 100)
Overall Assessment Division

The annual examination comprises 100 marks, with 40 marks allocated to the Theory Paper and 60 marks to the Practical component. Of the 19 SLOs in the Grade IX curriculum, 07 are assessed exclusively through theory, 07 exclusively through practical assessment, and the remaining 5 through both components. For SLOs assessed in both components, theoretical understanding is evaluated in the Theory Paper, while practical performance is assessed in the Practical component. The same evidence is not credited twice.

Component	Marks	Composition	Time allowed
Annual Theory Paper **Draws on 12 SLOs (07 theory-only + 5 dual).**	40	**Section A**: MCQs 1x8= 08 **Section B**: Short Response Questions 10x2=20 **Section C**: Extended Response Questions 2 × 6 = 12.	**2:30 hours**
Practical **Draws on 12 SLOs (07 practical-only + 05 dual).**	60	Hands-on practical skills = 20 Yearly project = 30 Viva voce = 10	**4 hours**
Total	**100**	19 unique SLOs — full Grade XI coverage.	

SLOs Categorization:

SR#	Theory Only	Practical Only	Dual (Theory + Practical)
1	AI-11-A-01	AI-11-A-03	AI-11-D-01
2	AI-11-A-02	AI-11-A-04	AI-11-D-02
3	AI-11-A-05	AI-11-C-01	AI-11-D-03
4	AI-11-E-02	AI-11-C-02	AI-11-E-05
5	AI-11-E-03	AI-11-D-04	AI-11-F-03
6	AI-11-F-01	AI-11-E-01	
7	AI-11-F-02	AI-11-E-04	

Federal Board HSSC-I Examination
Model Question Paper Artificial Intelligence & Robotics
National Curriculum 2026 (Inclusive Scheme of Studies 2024)

Section - A (Marks 08)

Time Allowed: 15 minutes

Section – A is compulsory. All parts of this section are to be answered on this page and handed over to the Centre Superintendent. Deleting/overwriting is not allowed.
Do not use lead pencil.

ROLL NUMBER					
0	0	0	0	0	0
1	1	1	1	1	1
2	2	2	2	2	2
3	3	3	3	3	3
4	4	4	4	4	4
5	5	5	5	5	5
6	6	6	6	6	6
7	7	7	7	7	7
8	8	8	8	8	8
9	9	9	9	9	9

Version No.			
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

Candidate Sign._____ **Invigilator Sign**. _____

Q1. Fill the relevant bubble against each question according to curriculum. Each part carries one mark.

Sr. #	Question	A	B	C	D	A	B	C	D
i.	What unique capability of AI enables it to transform industries beyond the capabilities of conventional automation?	Repeating task at high speed	Following fixed instructions	Learning from data to make decisions	Storing records in digital form	○	○	○	○
ii.	A school uses an AI system to predict which students may need extra academic support. The system is trained using students' previous grades, attendance, and assignment records. If the training data contains mostly records of high-performing students, what is the most likely effect?	AI will always make correct predictions	AI may produce biased or inaccurate predictions for other students	AI will not require any testing data	AI will automatically collect better-quality data	○	○	○	○
iii.	Which neural network is particularly suitable for processing image data?	FNN	CNN	RNN	LSTM	○	○	○	○
iv.	Which characteristic distinguishes a collaborative robot (cobot) from a traditional industrial robot?	It works in a fenced area separated from workers	It carries heavier loads at higher speed	It repeats on a fixed program that can't be changed	It limits its force and speed to work safely beside people	○	○	○	○
v.	A surgical robot allows a surgeon to perform precise movements during an operation. What is a key benefit of this technology?	Improved precision during surgical procedures	Reduced need for surgical instruments and equipment	Complete elimination of complications during surgery	Independent performance of complex surgical procedures	○	○	○	○
vi.	Which neural network architecture is best suited for learning patterns in time-series data by maintaining information across a sequence?	Auto-encoder	Recurrent Neural Network	Radial Basis Function Network	Multilayer Perceptron	○	○	○	○
vii.	An AI-based recruitment system rejects qualified applicants because its training data contains historical bias. Which ethical issue is most directly involved?	Bias and fairness	Privacy and data protection	Transparency and explainability	Accountability and responsibility	○	○	○	○
viii.	A rescue team needs to search a collapsed building where entering may be dangerous for humans. Which robot would be most suitable?	Delivery robot	Search-and-rescue robot	Agricultural robot	Space exploration robot	○	○	○	○

Federal Board HSSC-I Examination

THEORY MODEL QUESTION PAPER

ARTIFICIAL INTELLIGENCE & ROBOTICS

Time allowed: 2:15 Hours **Total Marks Sections B & C: 32**

SECTION – B (Marks 20)

Q2. Attempt the following questions. Each part carries TWO marks. (10 × 2 = 20)

Sr#	Question	OR	Question	Marks
i.	Define data-driven decision-making in AI. Give one example of how AI uses data to make a prediction.	**OR**	State two (02) potential challenges of using mission-driven robots in society.	2
ii.	A student uses the same dataset to train and test an AI model. Why might this give a misleading impression of the model's performance?	**OR**	State how communication and coordination enable swarm robots to accomplish a common task.	2
iii.	Differentiate between Machine Learning and Deep Learning in terms of feature extraction.	**OR**	A researcher wants to develop an AI system to recognize objects in images and another system to predict future values from weather data collected over time. Which neural network architecture would be suitable for each task, and why?	2
iv.	State how weights and biases contribute to the output of an artificial neuron.	**OR**	Write down one (01) benefit and one (01) limitation of using robots to assist elderly people.	2
v.	Differentiate between FNN and CNN with respect to their typical applications.	**OR**	How deep learning enables an AI system to automatically learn complex features from training data?	2
vi.	How autonomous navigation helps a delivery robot complete its mission?	**OR**	State two (02) ways in which AI is transforming a traditional industry.	2
vii.	Differentiate between collaborative robotics and swarm robotics. Give one example of each.	**OR**	A company is developing an AI system to predict crop diseases. It has two datasets: one contains clear, recent images of crops, while the other contains old and low-quality images. Which dataset should be preferred for training, and why?	2
viii.	Differentiate between a surgical robot and a rehabilitation robot based on their main purpose.	**OR**	State the role of an activation function in a neural network.	2
ix.	Identify the ethical concern when an AI facial recognition system has different accuracy levels for different groups of people. List any two (02) possible effects on the affected individuals.	**OR**	A hospital needs a robot to deliver medicines to different wards without continuous human control. How sensors and autonomous decision-making can help the robot complete its assigned mission.	2
x.	How do navigation and AI-based decision-making help a rescue robot avoid obstacles and reach a survivor safely?	**OR**	A hospital wants to introduce an AI system for patient monitoring. Identify any two (02) ethical responsibilities that should be considered.	2

SECTION – C (Marks 12)

Note: Attempt all questions. Marks of each question are given along with the question. (2 × 6 = 12)

Sr#	Question	OR	Question	Marks
Q3.	A manufacturing company introduces autonomous, mission-driven robots to perform repetitive tasks. Explain how these robots can improve productivity and workplace safety, and discuss two challenges the company may face during their implementation.	**OR**	Explain the basic structure of an artificial neural network. Describe the functions of the input layer, hidden layer, and output layer.	6
Q4.	A traffic-management department uses AI to predict traffic congestion. The AI model is trained using traffic data collected only during weekdays from 8:00 a.m. to 5:00 p.m. The system performs poorly on weekends and during nighttime. **a)** Explain why the training data may be responsible for this problem. **b)** How does the relevance of data affect the AI system's performance? **c)** Suggest what additional data should be collected to improve the system.	**OR**	Discuss the ethical concerns that may arise when AI technologies are used in real-world applications. Explain any three (03) of the following with suitable examples: Bias, fairness, accountability, and human rights.	6

SLO Mapping of each question:

Question	Content Domain	SLO	Cognitive Level	Marks
SECTION A				
Q1-i	A: Fundamentals of AI & Robotics	AI-11-A-01	Knowledge	1
Q1-ii	A: Fundamentals of AI & Robotics	AI-II-A-02	Application	1
Q1-iii	D: Machine Learning & AI Algorithms	AI-11-D-03	Knowledge	1
Q1-iv	E: Robotic Components & Advanced Robotics	AI-II-E-02	Understanding	1
Q1-v	E: Robotic Components & Advanced Robotics	AI-II-E-05	Understanding	1
Q1-vi	D: Machine Learning & AI Algorithms	AI-11-D-03	Understanding	1
Q1-vii	F: Ethics, Laws & Careers in AI & Robotics	AI-12-F-01	Understanding	1
Q1-viii	E: Robotic Components & Advanced Robotics	AI-II-E-03	Application	1
SECTION B				
Q2-i (f)	A: Fundamentals of AI & Robotics	AI-11-A-01	Knowledge	2
Q2-i (s)	E: Robotic Components & Advanced Robotics	AI-II-E-03	Understanding	2
Q2-ii (f)	A: Fundamentals of AI & Robotics	AI-II-A-02	Knowledge	2
Q2-ii (s)	E: Robotic Components & Advanced Robotics	AI-II-E-02	Understanding	2
Q2-iii (f)	D: Machine Learning & AI Algorithms	AI-II-D-01	Knowledge	2
Q2-iii (s)	D: Machine Learning & AI Algorithms	AI-11-D-03	Understanding	2
Q2-iv (f)	D: Machine Learning & AI Algorithms	AI-II-D-02	Understanding	2
Q2-iv (s)	E: Robotic Components & Advanced Robotics	AI-II-E-05	Understanding	2
Q2-v (f)	D: Machine Learning & AI Algorithms	AI-11-D-03	Understanding	2
Q2-v (s)	D: Machine Learning & AI Algorithms	AI-II-D-01	Knowledge	2
Q2-vi (f)	E: Robotic Components & Advanced Robotics	AI-II-E-03	Understanding	2
Q2-vi (s)	A: Fundamentals of AI & Robotics	AI-11-A-01	Knowledge	2
Q2-vii (f)	E: Robotic Components & Advanced Robotics	AI-II-E-02	Understanding	2
Q2-vii (s)	A: Fundamentals of AI & Robotics	AI-II-A-02	Knowledge	2
Q2-viii (f)	E: Robotic Components & Advanced Robotics	AI-II-E-05	Understanding	2
Q2-viii (s)	D: Machine Learning & AI Algorithms	AI-II-D-02	Understanding	2
Q2-ix (f)	F: Ethics, Laws & Careers in AI & Robotics	AI-12-F-01	Application	2
Q2-ix (s)	E: Robotic Components & Advanced Robotics	AI-II-E-03	Application	2
Q2-x (f)	E: Robotic Components & Advanced Robotics	AI-II-E-03	Application	2
Q2-x (s)	F: Ethics, Laws & Careers in AI & Robotics	AI-12-F-01	Application	2
SECTION C				
Q3 (f)	E: Robotic Components & Advanced Robotics	AI-II-E-03	Knowledge	6
Q3 (s)	E: Robotic Components & Advanced Robotics	AI-II-D-02	Knowledge	6
Q4 (f)	A: Fundamentals of AI & Robotics	AI-II-A-02	Understanding	6
Q4 (s)	F: Ethics, Laws & Careers in AI & Robotics	AI-12-F-01	Understanding	6

Table of Specifications (ToS) — Model Paper Artificial Intelligence & Robotics, Grade XI (HSSC-I)

Content Domain / Cognitive Level	Domain A: Fundamentals of AI & Robotics	Domain B: Practical Applications of AI & Robotics	Domain D: Machine Learning & AI Algorithms	Domain E: Robotic Components & Advanced Robotics	Domain F: Ethics, Laws & Careers in AI & Robotics	Total Marks	%age of Cognitive Level
Knowledge (K)	Q1-i (1) Q2-i (f) (2) Q2-ii (f) (2)	—	Q1-iii (1) Q2-iii (f) (2) Q2-v (s) (2) Q3 (s) (6)	Q2-vi (s) (2) Q2-vii (s) (2) Q3 (f) (6)	—	**26**	**36.11%**
Understanding (U)	Q2-i (s) (2) Q2-ii (s) (2) Q4 (f) (6)	—	Q1-vi (1) Q2-iii (s) (2) Q2-iv (f) (2) Q2-iv (s) (2) Q2-v (f) (2)	Q1-iv (1) Q1-v (1) Q2-vi (f) (2) Q2-vii (f) (2) Q2-viii (f) (2) Q2-viii (s) (2)	Q1-vii (1) Q4 (s) (6)	**36**	**50.00%**
Application (A)	Q1-ii (1)	—	—	Q1-viii (1) Q2-ix (f) (2) Q2-ix (s) (2)	Q2-x (f) (2) Q2-x (s) (2)	**10**	**13.88%**
Total Marks	**16**	**0**	**20**	**25**	**11**	**72**	**100%**
Total %ages	**22.22%**	**0%**	**27.78%**	**34.72%**	**15.28%**	**100%**	

Note:

1 This ToS does not reflect policy, but it is particular to this model question paper.
2 Proportionate / equitable representation of the content areas as per the defined ranges may be ensured.
3 The percentage of cognitive level is 30%, 50%, and 20% for knowledge, understanding, and application, respectively with **± 5%** variation.
4 While selecting alternative questions for Short Response Questions (SRQs) and Extended Response Questions (ERQs), it must be kept in mind that:
- Difficulty levels of both questions should also be same
- SLOs of both the alternative questions must be different

Key:

Question Number (part/ first choice) marks example: **Q2-i (f /s) (2)**

Question Number (part/ second choice) marks example: **Q3 (f / s) (6)**

ASSESSMENT MANUAL FOR PRACTICAL

(60 MARKS)

Component	Maximum Marks
Hands-on Practical Skills	20
Yearly Project	30
Viva Voce	10
Total Practical Assessment	**60**

Hands-on Practical Skills (2 x 10 = 20 Marks)

Students shall perform two (02) practical tasks assigned by the external examiner.
Sample practical list includes:

No.	Practical description	Related SLO
1	Write and run a Python program using variables, input statements, and arithmetic operators. Display the calculated results.	AI-11-C-01
2	Write a Python program that checks a list of temperature readings using conditions and loops. Display an alert when a reading exceeds a set limit.	AI-11-C-01
3	Define a Python Robot class with properties such as name, speed, and position. Create two objects and test methods for moving, stopping, and displaying their status.	AI-11-C-02
4	Define a Python Sensor class. Use its methods to update sample readings, display values, and check whether a limit has been crossed.	AI-11-C-02
5	Use a virtual servo motor to enter different angles and observe its movement on the screen. Record the results.	AI-11-A-04
6	Change the joint angles of a simulated robotic arm. Observe and record how these changes affect the gripper's position.	AI-11-A-04, AI-11-E-04
7	Train a simple model using labelled sensor readings to predict move, stop, or turn. Use its predictions in a robot simulation and compare them with fixed rules.	AI-11-A-03
8	Write a Python program that accepts readings from two virtual line sensors. Use conditions to display whether the robot should move forward, turn left, turn right, or stop.	AI-11-A-04
9	Write a Python program that trains a simple ML model using a teacher-provided dataset, such as flower measurements. Use it to predict categories for new inputs.	AI-11-D-04
10	Test pre-trained model on unseen data. Calculate its accuracy and display examples of correct and incorrect predictions.	AI-11-D-04
11	Run a teacher-provided Python notebook. Identify the input, hidden, and output layers, and observe how changing the number of training rounds affects performance.	AI-11-D-02
12	Run supplied ML and deep learning programs on the same classification dataset. Compare their model structures, accuracy, and training time.	AI-11-D-01
13	Run a teacher-provided image recognition model on classroom object images. Test images with different backgrounds and lighting and record the predictions.	AI-11-E-04

No.	Practical description	Related SLO
14	Program a robotic arm to move an object between two marked positions. Test different starting positions and record successful and unsuccessful attempts.	AI-11-E-04
15	Write a Python program that accepts light readings from the robot's left and right sensors. Display a command to turn toward the brighter side or move forward when both readings are equal.	AI-11-C-01

Assessment Criteria of Han ds-on practical skills:

Criterion	Marks
Implementation Follows correct steps and uses suitable programming concepts or simulation tools.	**5**
Working Output Runs the program or simulation and produces the required output.	**3**
Testing and Observations Tests different inputs or settings and records observations.	**2**

The practical examination shall be assessed according to the prescribed practical tasks and the student's demonstrated performance.

Yearly Project (30 Marks)

Description
Design, implement, and demonstrate a small AI and Robotics project that addresses a real-world problem using Python and suitable robotics hardware. The **project report** should include the following topics **(15 to 20 Pages)** : 1. **Title Page** - Project title, student names, class, and institution. 2. **Project Overview** - Introduction, problem statement, objectives, and expected outcomes. 3. **Hardware and Software Requirements** - Components, tools, and their purposes. 4. **Dataset or Inputs** - Data sources, selection, preparation, and sample inputs. 5. **Algorithm and Model Selection** - Selected approach and reasons for choosing it. 6. **System Design** - Workflow, flowchart, circuit diagram, and hardware connections. 7. **Python Implementation** - Use of variables, operators, control structures, classes, and objects. 8. **Hardware Integration** - Assembly, programming, and communication between components. 9. **Testing and Model Evaluation** - Test cases, performance measures, errors, and observations. 10. **Results and Discussion** - Outputs, photographs, screenshots, and achievement of objectives. 11. **Robotics Applications** - Relevant computer vision and robotic arm applications, with analysis of bio-inspired and healthcare robotics. 12. **Challenges and Limitations** - Problems encountered, solutions attempted, and remaining limitations. 13. **Conclusion and Future Improvements** 14. **References** 15. **Appendices** - Source code, additional diagrams, and detailed test results. **** Subject Teacher/ Instructor and HOD/Principal with name, signature and stamp for verification***

Assessment Criteria (Yearly Project)		Marks
Problem and Planning	Problem and objectives (1); logical workflow or flowchart (1).	**2**
Python Programming	Correct use of variables and operators (1), conditions and loops (2), and classes and objects (2).	**5**
Dataset and AI Model	Suitable data selection and preparation (2); model selection with reasons (1); correct model implementation (2).	**5**
Robotics Hardware	Correct assembly and connections (2); communication between Python and hardware (2); hardware performs the required task (2).	**5**
Testing and Results	Suitable test cases (1); model performance measured using unseen data (1); complete system tested and errors explained (2).	**4**
Project Report	Complete and clearly organized report (1); diagrams, photographs, and results (1); discussion of computer vision, robotic arms, bio-inspired and healthcare robotics (1); conclusion and sources (1).	**5**
Demonstration and Presentation	Project demonstration (2); explanation (2).	**4**

Sample Yearly Projects List

- **Simple Waste-Sorting System**
  Develop a system that recognizes two types of clean waste, such as paper and plastic, using a camera and a supplied image model. Use a servo motor to move a sorting flap. Test different samples and record correct and incorrect sorting.
- **Smart Plant-Watering System**
  Develop a system that reads soil moisture and uses a supplied model to identify dry or wet soil. Turn on a small pump or indicator when watering is needed. Test different readings and compare the model's decisions with a simple fixed rule.
- **Robot That Stops at Obstacles**
  Develop a small robot that moves forward and stops when an obstacle is detected. Use a distance sensor and a supplied model that identifies the path as clear or blocked. Test objects at different distances and record the robot's responses.
- **Simple Line-Following Robot**
  Develop a robot that follows a marked line using two sensors. Use starter code and a supplied model to select forward, left, or right movement. Test the robot on a short track and record correct turns and mistakes.
- **Open-and-Close Robotic Gripper**
  Develop a gripper that opens or closes when a camera recognizes one of two hand gestures. Use a supplied gesture model and a servo motor. Compare the gripper's movement with a human hand and describe one possible assistive use.
- **Mini Healthcare Delivery Robot**
  Develop a robot that carries a lightweight dummy supply package along a short, marked hospital route. Use a supplied image model to recognize a destination marker and stop. Test delivery attempts and describe one benefit and one limitation of healthcare robots.
- **Simple Object-Picking Arm**
  Use a preassembled robotic arm to recognize and move a lightweight object from one fixed position to another. Use a camera and a supplied image model. Record recognition errors and successful picking attempts and explain a possible assistive application.
- **Robot That Follows a Target**

Develop a robot that recognizes one selected target using a camera and a supplied image model. Use starter code to turn toward the target or move forward. Test it in a small, clear area and record when it follows or loses the target.

- **Simple Object-Checking System**
  Develop a system that identifies two arrangements of coloured blocks: correct and incorrect. Run supplied traditional ML and neural-network models and compare their predictions. Use an LED or servo indicator to display the result and record which model makes fewer errors.
- **Robot Temperature Monitor**
  Develop a system that reads a robot motor's temperature and uses a supplied model to identify normal or unusual readings. Display a message and activate an indicator when needed. Use teacher-provided sample readings to test unusual conditions and record correct detections and false alerts.

Viva Voce (5 x 2 = 10 Marks)

Questions shall assess theoretical knowledge, practical implementation, programming logic, and understanding of AI applications and Robotics.

Note: Only five questions will be asked. No additional question is allowed.

Assessment Summary

Component	Maximum Marks
Theory Paper	**40**
Practical Paper	**60**
Grand Total	**100**

Laboratory Requirements

The institution should arrange the facilities required by the prescribed practical syllabus, such as:

- Computers with suitable processing capabilities.
- Python or another officially prescribed programming environment.
- Required libraries or software tools.
- Approved datasets or sample input files.
- Internet access, if required and permitted.
- Robotics hardware lab.
- Project documentation and practical assessment sheets.

External Examiner

To promote transparency, reliability, and validity, practical examinations shall be conducted and assessed in accordance with the applicable FBISE examination policy.

Responsibilities

- Oversee the practical examination process.
- Ensure that examinations follow the prescribed policy and practical syllabus.
- Evaluate students' hands-on AI and Robotics skills.
- Assess the student's understanding of algorithms, implementation, testing, and outputs.
- Verify and sign the final mark sheets as required.
- Maintain fairness and address examination-related concerns.
- Ensure that the required computers, laboratory facilities, software, and hardware are available.
- The number and appointment of external examiners shall follow the applicable FBISE policy.

Supporting Staff (Internal)

Lab Assistant / Technical Support Staff

- Prepare computers, laboratory equipment, and required software.
- Check the availability of Python or other prescribed programming environments.
- Arrange datasets, practical instructions, and project/portfolio folders.
- Ensure that the required software libraries and tools are available.
- Assist with technical issues without completing practical tasks on behalf of students.
- Maintain the laboratory environment during the examination.

Lab Attendant

- Assist in preparing the laboratory.
- Help arrange computers and examination materials.
- Support the laboratory staff in maintaining an orderly examination environment.
- Facilitate the logistical requirements of external examiners.

Federal Board HSSC-I Examination

PRACTICAL MODEL QUESTION PAPER

ARTIFICIAL INTELLIGENCE & ROBOTICS

Time Allowed: 4 Hours **Total Marks: 60**

Instructions:

1. Attempt all questions.
2. Write clear and properly identified Python code wherever required.
3. Display appropriate outputs and explain the results where necessary.
4. Marks will be awarded according to the candidate's performance, accuracy, implementation, and understanding.

Q1. Develop a Python-based Robot Management System using object-oriented programming (OOP). The program should: **5x2=10 Marks**

- **a)** Create a Robot class with suitable attributes.
- **b)** Use a constructor to initialize robot information.
- **c)** Define methods to display robot information and update the battery level.
- **d)** Create at least two robot objects.
- **e)** Display the updated information of both robots.

Q2. A dataset contains students' study hours, attendance, previous test marks, and final results (Pass/Fail). Using Python, perform the following tasks: **5x2=10 Marks**

- **a)** Load or create a suitable dataset. Inspect its contents and identify missing values.
- **b)** Separate the input features from the final result and divide the dataset into training and testing sets.
- **c)** Handle missing values, encode the results into numerical values, and scale the input features. Fit pre-processing steps on the training data and apply them to the testing data.
- **d)** Build and train a simple neural network. Identify its input, hidden, and output layers.
- **e)** Test the model on unseen data, report its accuracy, and predict the result of a new student.

Q3. Yearly Project **30 Marks**

Q4. Viva voce **5x2=10 Marks**