ICSE

INDIAN CERTIFICATE OF SECONDARY EDUCATION EXAMINATION

YEAR 2028

ROBOTICS AND ARTIFICIAL INTELLIGENCE (66)

Developed by:
Research, Development and Curriculum Division (RDCD)
CISCE

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ETHOS OF CISCE

- Trust and fair play.
- Minimum monitoring.
- Allowing schools to evolve their own niche.
- Catering to the needs of the children.
- Giving freedom to experiment with new ideas and practices.
- Diversity and plurality - the basic strength for evolution of ideas.
- Schools to motivate pupils towards the cultivation of:
  Excellence - The Indian and Global experience.
  Values - Spiritual and cultural - to be the bedrock of the educational experience.
- Schools to have an 'Indian Ethos', strong roots in the national psyche and be sensitive to national aspirations.

CLASS X

THEORY: 100 Marks

*There will be **one** written paper of **two hours** duration carrying 100 marks and internal assessment of 100 marks.*

DISTRIBUTION OF MARKS FOR THE WRITTEN PAPER

S. NO.	UNIT	TOTAL WEIGHTAGE
	PART I: ROBOTICS	
1.	**New Age Robotic Systems**	**12 Marks**
2.	**Components of Robots as a System**	**15 Marks**
3.	**Visualization, Design and Creation of Components**	**15 Marks**
4.	**Integrating Robots as a System**	**8 Marks**
	PART II: ARTIFICIAL INTELLIGENCE	
1.	**Decision making in Machines/ Computers**	**8 Marks**
2.	**Machine Intelligence and Cybersecurity in Computing**	**8 Marks**
3.	**Components of AI Project Framework**	**14 Marks**
4.	**Introduction to Data and Programming with Python**	**20 Marks**
TOTAL		**100 Marks**

PART I

ROBOTICS

Note: Key concepts of Class IX need to be revised as a prerequisite

1. New Age Robotic Systems

(i) Types of Robots

Warehouse Robots, Assistant Robots, Smart Homes, Smart Schools, Smart mobility, Autonomous Cars/Driver Assisted Cars, Autonomous Drones, Robotics for Medicine and Healthcare, any other (give examples). Why NARS are relevant and possible. Some common examples of robotic systems such as, elevator.

(ii) Difference between a machine and a robot.

Difference between a machine and a robot: an understanding of how a robot must continuously sense, maintain a certain speed and do a certain task that it is programmed to do, using examples; identification of machine/robot through illustrations.

(iii) Cobots

Meaning of Cobots (as robotic systems with humans in the loop, emphasizing the provision for human interaction and a multi robot system); difference between Cobot and Robot, importance of cobots, a brief understanding of the progress from Robots to Cobots.

2. Components of Robots as a System

(i) Introduction to Gears.

Use of gears in robots- transmission and amplification of force, principles of gears, types of gears, gear ratio (brief understanding with examples).

(ii) Sensors in Robotics.

Types of Sensors based on application (Vision, tactile, temperature, range and proximity detection, motion, navigation, speech recognition) with examples only.

Classification of sensors as Internal Sensors (Position, Velocity, Acceleration and Force Sensors) and External Sensors (Contact type, Non-contact Type Sensors). Functions of sensors.

(iii) Actuators.

Brief understanding of actuators and their application; types of actuators (linear and rotary) with examples such as joints and wheels.

(iv) Controller for a Robotic System.

Examples of control systems from daily life: regulation of fan, refrigerator, and air conditioner.

Control systems in robotics: Meaning, functions and working; differences between manual and automatic control systems. Block diagrams to be used to illustrate.

(Input-controller-robot-feedback).

(v) Integrating Sensors, Actuators and Controller in a Robotic System.

Illustration using a simple example: how angular position is measured by a position sensor of a robotic arm is controlled by driving the revolute joint using a motor.

3. Visualization, Design and Creation of Components

(i) Application of Mechanical Block of Robotics.

Visualize, design and create components of a robot.

Using Tinkercad to visualize, design, and create the components of a robot; the different types of joints: revolute and prismatic, RR Mechanism.

(ii) Visualization of motion.

Use of Tinkercad to visualize motion of the components designed.

4. Integrating Robots as a System

Building simple robotic systems, wheeled mobile robot, Single Board Computer coding.

Using Tinkercad to build simple robotics systems, for example, RR Mechanism. Building simple systems up to a mobile robot with four wheels.

PART II
ARTIFICIAL INTELLIGENCE

Note: Key concepts of Class IX need to be revised as a prerequisite.

1. Decision making in Machines/ Computers

(i) Automated versus Autonomous Systems.

Concept of Automated versus Autonomous Systems for Deterministic versus Probabilistic versus.

(ii) Decision Making.

Human versus machine decision making as subjective and objective respectively; An understanding of object classification by humans and computers/machines.

(iii) Machine Learning (ML).

A brief understanding of Machine Learning, role of data and information. Steps in machine learning. Importance of programming and algorithms in teaching machines/computers in subjective decision making.

Example such as fruit sorting.

2. Machine Intelligence and Cybersecurity in Computing

(i) Machine Intelligence – Turing Test.

Human intelligence vs Machine Intelligence; role of the Turing test in AI: a brief understanding only; connectivity between human intelligence and machine intelligence.

(ii) Cybersecurity

A basic understanding of security and ethical issues such as the unauthorized use of hardware, theft of software, disputed rights to products, the use of computers to commit fraud, the phenomenon of hacking and data theft, sabotage in the form of viruses, responsibility for the reliability of output, making false claims for computers, and the degradation of work.

3. Components of AI Project Framework

(i) Problem Scoping

Understanding of problem and finding out which factors affect the problem, defining the goal of the project. The 4 Ws: Who, What, Where, Why. The Problem Statement

(ii) Data Acquisition

Types of Data, Data Features, Data Sources, Training and testing Data and System Maps. Importance of acquiring relevant data from reliable sources.

Sources of Dataset in AI – Kaggle Platform

(iii) Data Exploration

An understanding of different ways of representing data to gather meaningful information: Bar graphs/ histograms, line graphs, scatter plots, pie charts.

(iv) Modelling and Evaluation

Approaches in AI data modelling: Prediction – linear regression. Rule based approach, learning based approach, supervised learning, unsupervised learning (brief understanding of each).

4. Introduction to Data and Programming with Python

(i) Modules and Packages.

Scope and uses of packages, modules and libraries like NumPy, Pandas, SciPy, Matplotlib; implementation using simple programs in python.

An understanding of what libraries are and why we need them in the first place, the syntax of importing libraries.

(ii) Lists and Tuples in Python.

Introduction to lists, creation of list, access elements of a list, list operations (append, insert, extend, sort, search)

Introduction to tuples, creation of tuple, accessing tuples, deleting a tuple, and converting list to tuple and vice-versa.

(iii) Strings

Introduction to strings, creating strings, traversing a string, multiline strings, concatenating strings, escape sequences. String operators, string in-built functions:

int string.len()

string string.upper()

string string.lower()

boolean string.endswith(*value)*

boolean string.startswith(*value)*

int string.find(*value)*

boolean string.islower()

string string.replace(*oldvalue, newvalue)*

int string.count(*value)*

boolean string.isalpha()

boolean string.isdigit()

boolean string.isalnum()

string string.join(*iterable*)

*string s*tring[start:end:step]

INTERNAL ASSESSMENT: 100 Marks

Students are expected to do a minimum of **20 assignments** during the year to reinforce concepts studied in class. The details are as follows:

Details of Assignments to be done during the year

Broad Area	Number of Assignments
Robotics	3
Artificial Intelligence	2
Python (Programming)	15
TOTAL	**20**

The teacher-in-charge should maintain a record of all the assignments done as a part of practical work throughout the year and give it due credit at the time of cumulative evaluation at the end of the year.

SUGGESTED LIST OF ASSIGNMENTS:

Some sample problems are given below as examples. The problems are of varying levels of difficulty:

Robotics

1. Make a presentation on the difference between a machine/robot/cobot.
2. Technology is evolving at a fast pace. What does it mean for us? Discuss.
3. Are smart systems making humans less smart? Discuss.
4. Prepare a report on robotics systems being used in different spheres of life?

Artificial Intelligence (AI)

1. Create a concept map of a smart transport management systems for a school. (Refer Tony Buzan concept map).
2. Create a chart for AI enabled query management system for a school. (Refer Tony Buzan concept map). Use AI Project Framework.
3. Ideate and prepare a presentation on how AI could be used in a school. Which areas in a school can be benefitted using AI? Using AI Project framework ideate the implementation of AI towards a smart school.

Python Programming

1. Create a list of all students in your class and sort them in alphabetical order.
2. Find a word string of interest in a given sentence. For the same string match for exact case if a particular word string is present in a given sentence. Display output “String Name Found”, or “String Name Not Found”
3. Make a dictionary dataset of all cities in India and store their average temperature and pollution details.
4. Create Numpy arrays
   (a) Getting elements from Numpy arrays using index values.
   (b) Numpy array slicing.
   (c) Getting Numpy array shape and reshaping them.
   (d) Iterating a Numpy array.

(e) Join and split Numpy arrays.

(f) Searching and sorting of Numpy arrays.

(g) Using mean, median and mode methods given in Numpy.

5. Display an image using matplotlib and print its numpy array form. Also check the data type and shape of the numpy array. Use the library 'skimage' for getting sample images.
6. Reading a .csv file into a Pandas DataFrame .
7. Reading json data into a Pandas DataFrame.
8. Basic data analysis on data with info(), tail(), head() commands.
9. Plotting x and y point arrays on a plot.
10. Using different type of markers and line styles on the plot.
11. Declaring labels for the axis. (Plot selling price and original price).
12. Plotting bar graphs - Use the bestselling book dataset to plot year wise data and find out what genre was bestselling across years.
13. Plotting histograms - Use the top 200 YouTubers' dataset to plot and find out what genre was most liked. Also plot followers using histogram for each genre.
14. Creating a normal distribution and displaying in graph (using Numpy + Matplotlib) - Display the scores of students in a graph and check if it is a normal distribution? What is the mean, median and mode of this data?
15. Write a Python program to calculate the electricity bill. Accept the last meter reading and current meter reading and the rate per unit from the user. Calculate the number of units and total bill consumption for the user.
16. A company decided to give bonus of 5% to an employee if his/her year of service is more than 5 years. Write a Python program to ask the user for their salary and year of service and print the net bonus amount.

NOTE: This list is indicative only. Teachers and students should use their imagination to create innovative and original assignments.

EVALUATION OF PROGRAMMING ASSIGNMENTS

The teacher-in-charge shall evaluate all the programming assignments done by the student throughout the year (both written and practical work). He/she shall ensure that most of the components of the syllabus have been used appropriately in the assignments. Assignments should be with appropriate list of variables and comment statements. The student has to mention the output of the programs.

Proposed Guidelines for Marking

The teacher should use the criteria below to judge the internal work done. Basically, four criteria are being suggested: class design, coding and documentation, variable description and execution or output. The actual grading will be done by the teacher based on his/her judgment. One possible way: divide the outcome for each criterion into one of 4 groups: excellent, good, fair/acceptable, poor/unacceptable, then use numeric values for each grade and add to get the total.

Class design:

Has a suitable class (or classes) been used?

Are all attributes with the right kinds of types present?

Is encapsulation properly done?

Is the interface properly designed?

Coding and Documentation:

Is the coding done properly? (Choice of names, no unconditional jumps, proper organization of conditions, proper choice of loops, error handling, code layout) Is the documentation complete and readable? (class documentation, variable documentation, method documentation, constraints, known bugs - if any).

Variable description:

Format for variable description:

Name of the Variable	Data Type	Purpose/description

Execution or Output:

Does the program run on all sample input correctly?

Evaluation of programming assignments will be done as follows:

Subject Teacher (Internal Examiner)	50 marks
External Examiner	50 marks

Criteria (Total-50 marks)	Class design (10 marks)	Variable description (10 marks)	Coding and Documentation (10 marks)	Execution OR Output (20 marks)
Excellent	10	10	10	20
Good	8	8	8	16
Fair	6	6	6	12
Poor	4	4	4	8

An External Examiner shall be nominated by the Head of the School and may be a teacher from the faculty, but not teaching the subject in the relevant section/class. For example, A teacher of Computer Science of class XII may be deputed to be the External Examiner for class X.

The total marks obtained out of 100 are to be sent to CISCE by the Head of the school.

The Head of the school will be responsible for the online entry of marks on CISCE's CAREERS portal by the due date.

LABORATORY EXPERIMENTS FOR DEMONSTRATION

The following experiments can either be demonstrated physically by the teacher using a Kit/ using audio- visual material. Alternatively, these may be taken up as group projects under the guidance of the teacher.

Programmable Mobile Robots:

*Line follower, Obstacle avoidance and Edge Detection Mobile Robots.

Note: The purpose of these laboratory experiments is to familiarize students with robotics systems and are not a part of the evaluation.

**A line follower robot will be able to follow a drawn line on the floor and move accordingly. An obstacle avoidance robot will be able to detect any solid object that comes along its path and change its direction to avoid it. An edge detection mobile robot will move on the table be able to detect the edges and prevent itself from falling off the table.*

All these are excellent examples of sensors in action. These robots can help in understanding how the sensors interface with the microcontrollers to automate a specific tasks.

A plethora of examples of these systems are found in manufacturing plants, autonomous driving vehicles, space programs, automatic vacuum cleaners etc.

The fundamental design of these robots are strategically placed sensors which enable them to work in a more specialised manner. Both the Line Following and Edge Detection Robots employ a couple of IR sensors but their placement makes them perform different tasks.

In case of Line Follower, the IR sensors are placed close to each other to help in following a predefined path whereas, the edge detector has widely placed IR sensors to maximise coverage area thus preventing itself from falling off from a surface. The Obstacle Avoider Robot employs an Ultrasonic Sensor which automatically detects if any object comes in front of it at a pre-defined distance and changes its course accordingly.

LABORATORY REQUIREMENTS

(For a Class of 30 students)

Item	Number
Computer Laboratory Desktop PCs with Python and Tinkercad installed	15
Registration ids on Tinkercad for student user	30
Miscellaneous	Screwdrivers, Allen wrench, soldering station
For Laboratory Experiments	
Single Board Computer (*e.g.* Arduino uno/nano ble sense, raspberry pi)	10 sets
Robotics Components: Servo motors, sensors (Ultrasonic,IR), wires, batteries, crimper, LED	10 sets
Programmable Mobile Robots: Line follower, obstacle avoidance and Edge Detection Mobile Robot. *The aforementioned Programmable mobile robots are available as a DIY kit and can also be easily built using the Robotic components.*	