FEDERAL MINISTRY OF EDUCATION

## National Technical Certificate (NTC) Curriculum in

# ARTIFICIAL INTELLIGENCE (AI) & MACHINE LEARNING CRAFT

**February, 2025**

NATIONAL BOARD FOR TECHNICAL EDUCATION
NBTE

Innovation Development and Effectiveness in the Acquisition of Skills (IDEAS) Project

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**NATIONAL BOARD FOR TECHNICAL EDUCATION**
Plot B, Bida Road, P.M.B. 2239, Kaduna, Nigeria

## NATIONAL TECHNICAL CERTIFICATE

## CURRICULUM AND MOUDULE SPECIFICATIONS IN

# ARTIFICIAL INTELLIGENCE (AI) & MACHINE LEARNING CRAFT

**2025**

## GENERAL INFORMATION

### AIM

To train and equip students with the necessary knowledge and skills in Artificial Intelligence (AI), enabling them to develop AI-powered solutions, analyze data, and implement AI models for various industries.

### ENTRY QUALIFICATIONS

### Craft Programme

Candidates must be at least 14 years old and should have successfully completed three years of Junior Secondary education or its equivalent. Special consideration may be given to candidates with trade test certificates and relevant experience.

Candidates should possess the National Technical Certificate (NTC) or its equivalent and should have a minimum of two years post-qualification cognate industrial experience. The Curriculum

The Curriculum of each programme is broadly divided into three components:

a. General Education, which accounts for 30% of the total hours required for the programme.

b. Trade Theory, Trade Practice and Related Studies which account for 65% and,

c. Supervised Industrial Training/Work Experience which accounts for about 5% of the total hours required for the programme. This component of the course which may be taken in industry or in the College production unit is compulsory for the full-time students.

Included in the curriculum are the teacher's activity and learning resources required for the guidance of the teacher.
Unit Course/Modules

A course/module is defined as a body of knowledge and skills capable of being utilized on its own or as a foundation or pre-requisite knowledge for more advanced work in the same or other fields of study. Each trade course/ module when successfully completed can be used for employment purposes.

**Behavioural Objectives**
These are educational objectives, which identify precisely the type of behaviour a student should exhibit at the end of a course/module or programme. Two types of behavioural objectives have been used in the curriculum. They are:

a. General Objectives
b. Specific Learning Outcomes

General objectives are concise but general statements of the behavior of the students on completion of a unit of week such as understanding the principles and application of:
a Artificial Intelligence
b Data Science
c Machine Learning

Specific learning outcomes are concise statements of the specific behavior expressed in units of discrete practical tasks and related knowledge the students should demonstrate as a result of the educational process to ascertain that the general objectives of course/ programme have been achieved. They are more discrete and quantitative expressions of the scope of the tasks contained in a teaching unit.

**General Education in Technical Colleges**
The General Education component of the curriculum aims at providing the trainee with knowledge in critical subjects like English Language, Mathematics, Economics, Physics, Chemistry, Biology, Entrepreneurial Studies and Mathematics, etc. to enhance the understanding of machines, tools and materials of their trades and their application as a foundation for post-secondary technical education for the above average trainee. Hence, it is hoped that trainees who successfully complete their trade and general education may be able to compete with their secondary school counterparts for direct entry into Universities, Polytechnics or Colleges of Education (Technical) for degree, ND or NCE courses respectively.

For the purpose of certification, only the first three courses in mathematics will be required. The remaining modules are optional and are designed for the above average students.

**National Certification**

The NTC programmes are run by Technical Colleges accredited by N.B.T.E.
NABTEB conducts the final nnational examination and awards certificates.

Trainees who successfully complete all the courses/ modules specified in the curriculum table and passed the national examinations in the trade will be awarded one of the following certificates:

| S/NO | LEVEL | CERTIFICATE |
|---|---|---|
| | **Technical Programme** | |
| 1. | NTC | National Technical Certificate |

**Guidance Notes for Teacher implementing the Curriculum**

The number of hours stated in the curriculum table may be increased or decreased to suit individual institutions' timetable provided the entire course content is properly covered and goals and objectives of each module are achieved at the end of the term.

The maximum duration of any module in the new scheme is 300 hours. This means that for a term of 15 weeks, the course should be offered for 20 hours a week. This can be scheduled in sessions of 4 hours in a day leaving the remaining hours for general education. However, properly organized and if there are adequate resources, most of these courses can be offered in two sessions a day, one in the morning and the other one in the afternoon. In so doing, some of these programmes may be completed in lesser number of years than at present.

The sessions of 4 hours include the trade theory and practice. It is left to the teacher to decide when the class should be held in the workshop or in a lecture room.

## INTEGRATED APPROACH IN THE TEACHING OF TRADE

### Theory, Trade Science and Trade Calculation

The traditional approach of teaching trade science and trade calculation as separate and distinct subjects in Technical College programmes is not relevant to the new programme as it will amount to a duplication of the teaching of mathematics and physical science subjects in the course. The basic concepts and principles in mathematics and physical science are the same as in the trade calculation and trade science. In the new scheme therefore, qualified persons in these fields will teach mathematics and physical science and the instructors will apply the principles and concepts in solving trade science and calculation problems in the trade theory classes. To this end, efforts have been made to ensure that mathematics and science modules required to be able to solve technical problems were taken as pre-requisite

### Evaluation of Programme/Module

For the programme to achieve its objectives, any course started at the beginning of a term must terminate at the end of the term. Instructors should therefore device methods of accurately assessing the trainees to enable them give the student's final grades at the end of the term. A national examination will be taken by all students who have successfully completed their modules. The final award will be based on the aggregate of the scores attained in the course work and the national examination

**PROGRAMME: NATIONAL TECHNICAL CERTIFICATE IN ARTIFICIAL INTELLIGENCE (AI) & MACHINE LEARNING CRAFT.**

**GOAL:** The Artificial Intelligence and Machine Learning Craft programme aims to produce skilled professionals capable of designing, developing, and deploying AI and ML models across various industries. The trainee will gain proficiency in programming, data handling, model training, and real-world problem-solving using AI techniques. The programme also fosters innovation, ethical AI practices, and entrepreneurship to enable self-reliance and industry adaptability.

**OBJECTIVES**

i. Assist in application of essential mathematical concepts for AI and machine learning
ii. Apply the basics of programming for AI development.
iii. Assist in data collection, cleaning, analysis, and visualization techniques.
iv. Assist in the application of machine learning and deep learning concepts to build simple ML models.
v. Support in the applications of neural networks, deep learning techniques for AI development
vi. Support in the integration of AI with robotics and IoT to enhance automation and smart systems.
vii. Apply ethical considerations, biases in AI.
viii. Apply AI techniques in solving a real-world problems

## Table of Contents

**CURRICULUM TABLE AND COURSE HOURS/WEEK**
**PROGRAMME: NATIONAL TECHNICAL CERTIFICATE**

| Module Code | MODULE | YEAR I | | | | | | YEAR 2 | | | | | | YEAR 3 | | | | | | TOTAL HOURS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Term 1 | | Term 2 | | Term 3 | | Term 1 | | Term 2 | | Term3 | | Term 1 | | Term 2 | | Term 3 | | |
| | | T | P | T | P | T | P | T | P | T | P | T | P | T | P | T | P | T | P | |
| CAM 12 - 15 | Mathematics | 2 | - | 2 | - | 2 | - | 2 | - | 2 | - | 2 | - | 2 | - | 2 | - | 2 | - | 216 |
| CEN 11 - 17 | English | 2 | - | 2 | - | 2 | - | 3 | - | 3 | - | 3 | - | 3 | - | 3 | - | 3 | - | 288 |
| CPH 10 - 12 | Physics | 2 | - | 2 | - | 2 | - | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 288 |
| CCH 10 - 12 | Chemistry | 2 | - | 2 | - | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 288 |
| CBM 11 | Entrepreneurship | - | - | - | - | - | - | 2 | - | 2 | - | 2 | - | - | - | - | - | - | - | 72 |
| ICT 11 - 15 | Computer Studies | - | - | - | - | - | - | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | 1 | 2 | - | - | 180 |
| CAI 111 | Introduction to AI | 4 | 2 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 72 |
| CAI 112 | Basic Mathematics for Computing | - | - | 2 | 4 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 72 |
| CAI 133 | Fundamental of Programming | - | - | - | - | 2 | 4 | - | - | - | - | - | - | - | - | - | - | - | - | 72 |
| CAI 214 | Data Analytics and Visualization | - | - | - | - | - | - | 2 | 4 | - | - | - | - | - | - | - | - | - | - | 72 |
| CAI 235 | Introduction to Machine Learning and Deep Learning | - | - | - | - | - | - | - | - | 2 | 4 | - | - | - | - | - | - | - | - | 72 |
| CAI 316 | Deep Learning Applications | - | - | - | - | - | - | - | - | - | - | 2 | 4 | - | - | - | - | - | - | 72 |
| CAI 317 | Application of AI in Robotics and IoT | - | - | - | - | - | - | - | - | - | - | - | - | 2 | 4 | - | - | - | - | 72 |
| CAI 338 | AI Ethics and Governance | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 3 | 1 | - | - | 48 |
| CAI 339 | AI Capstone Project | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 | 5 | 72 |
| **Total** | | 10 | 1 | 11 | 3 | 10 | 5 | 14 | 8 | 13 | 5 | 13 | 6 | 15 | 10 | 12 | 8 | 13 | 8 | **1956** |

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| **PROGRAMME: ARTIFICIAL INTELLIGENCE (AI) & MACHINE LEARNING (ML) CRAFT** | | | | |
| **MODULE 1: Introduction to Artificial Intelligence** | | | **COURSE CODE: CAI 111** | **CONTACT HOURS: 72** |
| **YEAR:** 1 | **TERM:** 1 | **PRE: REQUISITE:** | **Theoretical:** 48 Hours<br>**Practical:** 24 Hour | |
| **GOAL:** This module is designed to introduce trainee with the knowledge and skills of the fundamental concepts of AI | | | | |

**GENERAL OBJECTIVES:**
On completion of this module, the trainee should be able to:

1.0 Understand the history and concept of AI

2.0 Understand the applications of AI in the real world

3.0 Understand the ethical considerations in AI

| PROGRAMME: ARTIFICIAL INTELLIGENCE (AI) & MACHINE LEARNING (ML) CRAFT | | | | | | |
|---|---|---|---|---|---|---|
| **MODULE 1: Introduction to Artificial Intelligence** | | | | **COURSE CODE: CAI 111** | | **CONTACT HOURS: 72** |
| **YEAR:** 1 | **TERM:** 1 | **PRE: REQUISITE:** | | **Theoretical:** 48 Hours<br>**Practical:** 24 Hour | | |
| **GOAL: This module is designed to introduce trainee with the knowledge and skills of the fundamental concepts of AI** | | | | | | |
| **Theoretical Content** | | | | **Practical Content** | | |
| **GENERAL OBJECTIVE 1.0:** Understand the history and concept of AI | | | | | | |
| **Week** | **Specific Learning Outcome** | **Teachers Activities** | **Learning Resources** | **Specific Learning Outcome** | **Teachers Activities** | **Learning Resources** |
| 1-4 | 1.1 Define Artificial Intelligence (AI)<br><br>1.2 Explain the significance of AI.<br><br>1.3 Explain the evolution of AI from early rule-based systems to modern machine learning techniques.<br><br>1.4 Explain major contributors to AI and their contributions.<br>1.6 Explain the types of AI<br>• Narrow AI<br>• General AI<br>• Super AI.<br><br>1.7 State examples of each AI in 1.6.<br><br>1.8 Explain the capabilities and limitations of each AI in 1.6 | Explain Artificial Intelligence (AI)<br>Discuss the significance of AI.<br><br>Discuss the evolution of AI from early rule-based systems to modern machine learning techniques.<br><br>Explain major contributors to AI and their contributions.<br>1.6 Explain the types of AI<br>• Narrow AI<br>• General AI<br>• Super AI.<br><br>Explain examples of each AI in 1.6. | Videos<br>Books<br>Articles<br>Whiteboard | Identify major contributions of AI in the societies. | Guide students to identify major contributions of AI in the societies. | Video clips<br>E-Libraries |

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| | 1.9 Explain the opportunities and challenges in achieving the three types of AI. | Explain the capabilities and limitations of each AI in 1.6<br><br>Explain the opportunities and challenges in achieving the three types of AI. | | | | |
| **GENERAL OBJECTIVE 2.0: Understand the applications of AI in the real world** | | | | | | |
| 5-9 | 2.1 Explain the applications of AI in the following field:<br>• Healthcare,<br>• Finance<br>• Transportation<br>• Agriculture<br><br>2.2 Explain how AI improves efficiency in various industries.<br>2.3 State the impact of AI on job markets and society.<br>2.4 State the working principles of AI powered voice assistants:<br>• Siri<br>• Alexa<br>• Google Assistant, etc.<br><br>2.5 Describe the applications of chatbots in customer service.<br>2.6 Describe recommendation systems used by the following platforms:<br>• Netflix<br>• YouTube | Explain the applications of AI in the following field:<br>• Healthcare,<br>• Finance<br>• Transportation<br>• Agriculture<br><br>Explain how AI improves efficiency in various industries.<br>Discuss the impact of AI on job markets and daily life.<br>Discuss the working principles of AI powered voice assistants:<br>• Siri<br>• Alexa<br>• Google Assistant, etc.<br>Explain the applications of chatbots in customer service.<br>Explain recommendation systems used by the following platforms: | Videos<br>Books<br>Articles<br>LMS and E-library | Identify real-world AI applications<br>Demonstrate the use of AI-powered tools:<br>• Google Lens,<br>• AI chatbots voice assistants), etc.<br>Defend the impact of AI on job markets and society.<br>Identify the working principles of AI powered voice assistants:<br>• Siri<br>• Alexa<br>• Google Assistant, etc. | Invite a guest speaker from the tech industry<br>Guide students to:<br>Identify real-world AI applications<br>Identify how AI improves efficiency in various industries<br>Demonstrate the use of AI-powered tools:<br>• Google Lens,<br>• AI chatbots voice assistants), etc. | Video clips<br>Google lens<br>AI Chat bots |

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| | • Amazon, etc. | • Netflix<br>• YouTube<br>• Amazon, etc. | | | | |
| **GENERAL OBJECTIVE 3.0:** Understand the ethical considerations in AI | | | | | | |
| 10-12 | 3.1 Explain ethical concerns related to AI, (including bias and fairness.)<br>3.2 Explain privacy risks associated with AI systems.<br><br>3.3 Describe social and economic challenges posed by AI adoption.<br>3.4 List frameworks for responsible AI development. | Explain ethical concerns related to AI, (including bias and fairness.)<br>Explain privacy risks associated with AI systems.<br>Discuss social and economic challenges posed by AI adoption.<br>List frameworks for responsible AI development | Videos<br>Books<br>Articles<br>LMS<br>E-library (KOHA) | | | |

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| **PROGRAMME: ARTIFICIAL INTELLIGENCE (AI) & MACHINE LEARNING (ML) CRAFT** | | | | |
| **MODULE 2: Basic Mathematics for Computing** | | | **COURSE CODE: CAI 112** | **CONTACT HOURS:** 72 |
| **YEAR:** 1 | **TERM:** 2 | **PRE: REQUISITE:** | **Theoretical:** 24 Hours<br>**Practical:** 48 Hours | |
| **GOAL:** This module is designed to equip students with essential mathematical concepts for AI and machine learning | | | | |
| **GENERAL OBJECTIVES:**<br>On completion of this module, the trainee should be able to:<br>1.0 Understand number systems and binary representation<br>2.0 Solve basic algebra and algebraic functions<br>3.0 Understand basic probability and statistics<br>4.0 Understand matrices and calculus for computing<br>5.0 Understand graph theory fundamentals | | | | |

| **PROGRAMME: ARTIFICIAL INTELLIGENCE (AI) & MACHINE LEARNING (ML) CRAFT** | | | | | | |
|---|---|---|---|---|---|---|
| **MODULE 2: Basic Mathematics for AI** | | | | **COURSE CODE: CAI 112** | | **CONTACT HOURS: 72** |
| **YEAR:** 1 | **TERM:** 2 | **PRE: REQUISITE:** | | **Theoretical: 2**4 Hours<br>**Practical:** 48 Hour | | |
| **GOAL:** This module is designed to equip students with essential mathematical concepts for AI and machine learning | | | | | | |
| **Theoretical Content** | | | | **Practical Content** | | |
| **GENERAL OBJECTIVE 1.0:** Understand number systems and binary representation | | | | | | |
| **Week** | **Specific Learning Outcome** | **Teachers Activities** | **Learning Resources** | **Specific Learning Outcome** | **Teachers Activities** | **Learning Resources** |
| 1-2 | 1.1Define Number System<br><br>1.2 Explain different number systems (Decimal, Binary, Octal, and Hexadecimal).<br><br>1.3 State the significance of binary representation in computing and AI. | Explain Number System<br><br>Explain different number systems (Decimal, Binary, Octal, and Hexadecimal).<br><br>Explain the significance of binary representation in computing and AI. | Lecture slides<br>Calculators<br>Worksheets<br>Videos<br>Marker boards<br>Projectors | Convert numbers between different number systems.<br><br>Perform basic binary arithmetic (addition, subtraction, multiplication, division). | Guide students to:<br>Convert numbers between different number systems.<br><br>Perform basic binary arithmetic (addition, subtraction, multiplication, division). | Calculators<br>Worksheets<br>Videos<br>Python IDE |
| **GENERAL OBJECTIVE 2.0:** Solve basic algebra and algebraic functions | | | | | | |
| **Week** | **Specific Learning Outcome** | **Teachers Activities** | **Learning Resources** | **Specific Learning Outcome** | **Teachers Activities** | **Learning Resources** |
| 3-5 | 2.1 Explain basic algebraic operations (addition, subtraction, multiplication, division).<br><br>2.2 Describe how to solve simple linear equations and inequalities. | Explain basic algebraic operations (addition, subtraction, multiplication, division).<br><br>Explain how to solve simple linear equations and inequalities. | Textbooks<br>Online resource<br>Lecture slides<br>Calculators<br>Worksheets<br>Videos<br>Marker boards<br>Projectors | Plot simple mathematical functions.<br>Interpret simple mathematical functions. | Guide students to:<br>Plot simple mathematical functions.<br>Interpret simple mathematical functions. | Calculators<br>Worksheets<br>Videos<br>Smart Baord<br>LMS discussion board |

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| | 2.3 State the concept of functions and their role in AI. | Discuss the concept of functions and their role in AI | Smart Board<br>LMS Discussion Baord | Solve simple linear equations and inequalities. | Solve simple linear equations and inequalities | |
| **GENERAL OBJECTIVE 3.0: Understand basic probability and statistics** | | | | | | |
| 6-8 | 3.1 Define probability<br>3.2 Describe basic probability concepts (events, outcomes, probability rules).<br>3.3 Explain the concepts of mean, median, mode, and standard deviation<br>3.4 Explain probability distributions in real-world applications.<br>3.5 State different types of probability distributions. | Explain probability<br>Explain basic probability concepts (events, outcomes, probability rules).<br>Explain the concepts of mean, median, mode, and standard deviation<br>Explain probability distributions in real-world applications.<br>Explain different types of probability distributions. | Textbooks<br>Online resource<br>Calculators<br>Worksheets<br>Videos<br>Marker boards<br>Projectors<br>Smart Board<br>LMS discussion board | Calculate mean, median, and mode from datasets.<br>Apply concepts of standard deviation and variance.<br>Apply probability and statistics to AI-related problems.<br>Interpret probability distributions in real-world applications. | Guide students to:<br>Calculate mean, median, and mode from datasets.<br>Apply concepts of standard deviation and variance.<br>Apply probability and statistics to AI-related problems.<br>Interpret probability distributions in real-world applications. | Calculators<br>Worksheets<br>Videos<br>Smart Baord<br>LMS discussion board |

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| **GENERAL OBJECTIVE 4.0:** Understand matrices and calculus for computing | | | | | | |
| 9-10 | 4.1 Describe the concept of matrices<br>4.2 Explain the properties of matrices.<br>4.3 State the role of matrices in AI, particularly in deep learning and computer vision. | Explain the concept of matrices<br>Describe the properties of matrices.<br>Discuss the role of matrices in AI, particularly in deep learning and computer vision. | Graphical tools<br>Textbooks<br>Online resource<br>Lecture slides<br>Worksheets<br>Videos<br>Marker boards<br>Projectors | Perform basic matrix operations (addition, subtraction, multiplication)<br><br>Apply matrices to simple AI problems. | Guide students to:<br>Perform basic matrix operations (addition, subtraction, multiplication)<br><br>Apply matrices to simple AI problems. | Calculators<br>Worksheets<br>Videos<br>Smart Baord<br>LMS discussion board |
| **GENERAL OBJECTIVE 5.0: Understand graph theory fundamentals** | | | | | | |
| 11-12 | 5.1 Define a graph<br>5.2 State the basics of graph theory (nodes, edges, adjacency matrix, degree).<br><br>5.3 State different types of graphs (directed, undirected, weighted, unweighted).<br><br>5.4 Explain graph traversal algorithms (BFS, DFS).<br><br>5.5 Explain graph applications in AI:<br>• Social networks<br>• Recommendation system | Explain graph<br>Explain the basics of graph theory (nodes, edges, adjacency matrix, degree).<br><br>Discuss different types of graphs (directed, undirected, weighted, unweighted).<br><br>Explain graph traversal algorithms (BFS, DFS).<br><br>Explain graph applications in AI:<br>• Social networks<br>• Recommendation system | Graphical tools<br>Textbooks<br>Online resource<br>Lecture slides<br>Videos<br>Marker boards<br>Projectors | Apply graph theory to AI applications:<br>• Social networks<br>• Recommendation system<br><br>Demonstrate graph visualization using online tools. | Guide students to:<br><br>Apply graph theory to AI applications:<br>• Social networks<br>• Recommendation system<br><br>Demonstrate graph visualization using online tools. | Graphical tools<br>Textbooks<br>Online resource<br>Worksheets<br>Videos<br>Smart Board<br>LMS discussion board |

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| **PROGRAMME: ARTIFICIAL INTELLIGENCE (AI) & MACHINE LEARNING (ML) CRAFT** | | | | |
| **MODULE 3: Fundamentals of Programming** | | | **COURSE CODE: CAI 214** | **CONTACT HOURS: 72** |
| **YEAR:** 1 | **TERM:** 3 | **PRE: REQUISITE:** | **Theoretical: 2**4 Hours<br>**Practical:** 48 Hour | |
| **GOAL:** This module is designed to equip students the basics of programming for AI development. | | | | |

**GENERAL OBJECTIVES:**

On completion of this module, the trainee should be able to:

1. Know programming basics
2. Use control structures (Loops, Conditions and counters)
3. Use functions and modules
4. Utilize libraries and repo in coding (Numpy, Pandas)
5. Build simple system

| PROGRAMME: ARTIFICIAL INTELLIGENCE (AI) & MACHINE LEARNING (ML) CRAFT | | | | | | |
|---|---|---|---|---|---|---|
| **MODULE 3: Fundamentals of Programming** | | | | **COURSE CODE: CAI 214** | | **CONTACT HOURS:** 72 |
| **YEAR:** 1 | **TERM:** 3 | **PRE: REQUISITE:** | | **Theoretical: 24** Hours<br>**Practical:** 48 Hours | | |
| **GOAL:** This module is designed to equip students the basics of programming for AI development. | | | | | | |
| **Theoretical Content** | | | | **Practical Content** | | |
| **GENERAL OBJECTIVE 1.0: Know programming basics** | | | | | | |
| **Week** | **Specific Learning Outcome** | **Teachers Activities** | **Learning Resources** | **Specific Learning Outcome** | **Teachers Activities** | **Learning Resources** |
| 1-2 | 1.1 Explain the basic structure and syntax in C, Java, Python.<br><br>1.2 State different data types in Progamming:<br><br>• Integers,<br>• Floats,<br>• Strings,<br>• Booleans<br>• Lists<br>• Tuples<br>• dictionaries<br>• Sets<br><br>1.3. State the types of operators:<br><br>• Arithmetic<br>• Logical, | Explain the basic structure and syntax in C, Java, Python.<br><br>Explain different data types in Python:<br><br>• Integers,<br>• Floats,<br>• Strings,<br>• Booleans<br>• Lists<br>• Tuples<br>• dictionaries<br>• Sets<br><br>Explain types of operators (arithmetic, logical, comparison, assignment). | Python IDE<br>Code editor<br>Textbooks<br>Slides | Write basic programming algorism; apply the algorism in C, Java codes and Python scripts using variables and data types.<br><br>Perform arithmetic and logical operations in the algorism.<br><br>Debug simple syntax errors in C, Java and Python . | Guide students to:<br><br>Write basic programming algorism; apply the algorism in C, Java codes and Python scripts using variables and data types.<br><br>Perform arithmetic and logical operations in the algorism.<br><br>Debug simple syntax errors in C, Java and Python | VS Code<br>Python IDE<br>JDK<br>Github library |

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| | comparison<br>• Assignment<br><br>1.4 Differentiate the types of error in programming<br><br>1.5 Compare the difference in the C, Java and python<br>1.6 State the advantage of using python for AI development | Explain the types of error in programming<br><br>Compare and contrast the difference of the three programming<br><br>Explain the advantage of using python for AI related project | | | | |
| **GENERAL OBJECTIVE 2.0: Use control structures (Loops, Conditions and counters)** | | | | | | |
| 3-5 | 2.1 Explain the concept of control flow in programming.<br><br>2.2 Explain the use of conditional statements:<br><br>• If,<br>• Elif,<br>• Else).<br><br>2.3 Describe different types of loops:<br><br>• For,<br>• While<br>• Do-while | 2.1 Explain control flow and its importance in programming.<br><br>Explain the use of conditional statements:<br><br>• If,<br>• Elif,<br>• Else).<br><br>Explain different types of loops:<br><br>• For,<br>• While<br>• Do-while | Slides<br>Textbooks | Write Python programs using if, elif, and else statements.<br><br>Implement loops to iterate through lists and perform repeated tasks.<br><br>Debug programs with incorrect control structures.<br><br>Write pseudocode before writing actual Python code.<br><br>Use flowcharts to illustrate how loops and | Guide students to:<br><br>Write Python programs using if, elif, and else statements.<br><br>Implement loops to iterate through lists and perform repeated tasks.<br><br>Debug programs with incorrect control structures.<br><br>Write pseudocode before writing actual Python code.<br><br>Use flowcharts to illustrate how loops | VS Code<br>Python IDE<br>JDK |

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| | | | | conditionals work. | and conditionals work. | |
| **GENERAL OBJECTIVE 3.0: Use functions and modules** | | | | | | |
| 6-7 | 3.1 Explain functions in programming.<br><br>3.2 Explain the concept of reusable code using functions.<br><br>3.3. Explain function syntax and parameters.<br><br>3.4 Describe the concept of modular programming.<br><br>3.5 Explain how to import and use Python modules. | Discuss functions in programming.<br><br>Explain the concept of reusable code using functions.<br><br>Explain function syntax and parameters.<br><br>Describe the concept of modular programming.<br><br>Explain how to import and use Python modules | Python IDE<br>Code editor<br>Textbooks<br>Slides | Demonstrate function creation and calling in Python.<br><br>Pass parameters and return values from functions.<br><br>Import standard Python modules (e.g., math, random).<br><br>Create custom modules.<br><br>Identify examples of built-in and custom modules | Guide students to:<br><br>Demonstrate function creation and calling in Python.<br><br>Pass parameters and return values from functions.<br><br>Import standard Python modules (e.g., math, random).<br><br>Create custom modules.<br><br>Identify examples of built-in and custom modules | VS Code<br>Python IDE<br>JDK |
| **GENERAL OBJECTIVE 4.0: Utilize libraries and repo in coding (Numpy, Pandas)** | | | | | | |
| 8-9 | 4.1 Define Python library<br><br>4.2 Explain the purpose of external libraries in Python.<br><br>4.3 Explain the basic functionalities of NumPy and Pandas. | Explain Python library<br><br>Explain the purpose of external libraries in Python.<br><br>Explain the basic functionalities of | Python docs<br>Code editor<br>Textbooks<br>Slides | Import NumPy and Pandas.<br><br>Perform basic operations on arrays using NumPy.<br><br>Manipulate data | Guide students to:<br><br>Import NumPy and Pandas.<br><br>Perform basic operations on arrays using NumPy. | VS Code<br>Python IDE<br>Dataset |

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| | 4.4 Describe the importance of data manipulation in AI.<br><br>4.5 Explain the concepts of arrays and data frames. | NumPy and Pandas.<br><br>Describe the importance of data manipulation in AI.<br><br>Explain the concepts of arrays and data frames. | | using Pandas and Data Frames.<br><br>Demonstrate basic NumPy and Pandas operations. | Manipulate data using Pandas and Data Frames.<br><br>Demonstrate basic NumPy and Pandas operations. | |
| **GENERAL OBJECTIVE 5.0: Build simple projects in Python** | | | | | | |
| 10-12 | **5.1** Understand the basic structure of a Python program (e.g., defining functions, input/output).<br><br>**5.2** Write a Python script to solve a simple problem (e.g., a calculator or temperature converter).<br><br>**5.3** Use basic control structures (e.g., if-else, loops) to create decision-making processes in Python programs.<br><br>**5.4** Utilize Python libraries (e.g., math, random) to enhance functionality in simple projects.<br><br>**5.5** Debug and troubleshoot common errors in Python programs.<br><br>**5.6** Develop a basic Python | Provide a brief lecture on the basic structure of a Python programme (e.g., functions, variables, input/output).<br><br>Explain how to write a simple code to solve a simple problem using Python (e.g., building a basic calculator that performs addition, subtraction, multiplication, and division).<br><br>Explain how to import and use a library in a Python program by solving a simple problem (e.g., generating a random number game or | Python docs<br>Code editor<br>Textbooks<br>Slides | Apply Python concepts to build simple projects.<br><br>Develop small AI-related applications using Python.<br><br>Use problem-solving skills to debug and improve Python programs. | Offer feedback and suggestions for improvement.<br><br>Guide students to: Apply Python concepts to build simple projects.<br><br>Create a buggy Python program on purpose, then work with students to identify and fix the errors.<br><br>Develop small AI-related applications using Python.<br><br>Use problem-solving skills to debug and improve Python | VS Code<br>Python IDE |

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| | project (e.g., a simple game or a basic tool like a to-do list) by combining learned concepts. | calculating square roots).<br><br>Explain how to create a buggy Python program on purpose, then work with students to identify and fix the errors. | | | programs. | |

| PROGRAMME: ARTIFICIAL INTELLIGENCE (AI) & MACHINE LEARNING (ML) CRAFT | | | | |
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| **MODULE 4: Data Analytics and Visualization** | | | **COURSE CODE: CAI 133** | **CONTACT HOURS:** 72 |
| **YEAR:** 2 | **TERM: 1** | **PRE: REQUISITE:** | **Theoretical:** 24 Hours<br>**Practical:** 48 Hours | |
| **GOAL:** This module is designed to equip students with knowledge and skills of data collection, cleaning, analysis, and visualization techniques. | | | | |

**GENERAL OBJECTIVES:**

On completion of this module, the trainee should be able to:

1. Perform data collection and cleaning
2. Conduct basic data analysis and visualization
3. Use CSV and JSON files
4. Visualize data with Matplotlib and Seaborn
5. Perform simple data analysis techniques

| PROGRAMME: ARTIFICIAL INTELLIGENCE (AI) & MACHINE LEARNING (ML) CRAFT | | | | | | |
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| **MODULE 4: Data Analytics and Visualization** | | | | **COURSE CODE: CAI 133** | | **CONTACT HOURS: 72** |
| **YEAR:** 2 | **TERM:** 1 | **PRE: REQUISITE:** | | **Theoretical:** 24 Hours<br>**Practical:** 48 Hours | | |
| **GOAL:** This module is designed to equip students with knowledge and skills of data collection, cleaning, analysis, and visualization techniques. | | | | | | |
| **Theoretical Content** | | | | **Practical Content** | | |
| **GENERAL OBJECTIVE 1.0: Perform data collection and cleaning** | | | | | | |
| **Week** | **Specific Learning Outcome** | **Teachers Activities** | **Learning Resources** | **Specific Learning Outcome** | **Teachers Activities** | **Learning Resources** |
| 1-2 | 1.1 Explain data collection in AI and data science.<br><br>1.2 Explain different data sources (APIs, web scraping, databases, manual entry).<br><br>1.3 Explain different methods of data collection and sources<br><br>1.4 Explain the importance of data quality and cleaning in AI.<br><br>1.5 Describe common data issues (missing values, duplicates, incorrect data types). | Explain data collection in AI and data science.<br><br>Explain different data sources (APIs, web scraping, databases, manual entry).<br><br>Explain different methods of data collection and sources<br><br>Explain the importance of data quality and cleaning in AI.<br><br>1.5 Describe common data issues (missing values, duplicates, incorrect data types). | Slides<br>Videos<br>Textbooks<br>Projector<br>MS Excel<br>LMS<br>E-Library<br>Computer System<br>Internet access | Collect sample datasets from different sources.<br><br>Identify and handle missing data using Python (Pandas).<br><br>Remove duplicates and standardize data formats. | Guide students to:<br><br>Collect sample datasets from different sources.<br><br>Identify and handle missing data using Python (Pandas).<br><br>Remove duplicates and standardize data. | VS Code<br>Python IDE<br>W3Schools<br>Textbooks<br>Internet<br>Slides |

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| **GENERAL OBJECTIVE 2.0:** Conduct basic data analysis and visualization | | | | | | |
| 3-4 | 2.1 Explain the importance of data visualization in AI.<br><br>2.2 Identify different types of charts (bar charts, line graphs, scatter plots, histograms).<br><br>2.3 Describe when and why to use specific types of visualizations. | Discuss different types of charts and their use cases.<br><br>Compare and contrast the examples of effective and ineffective data visualizations.<br><br>Discuss best practices for designing clear and informative visualizations. | Slides<br>Videos<br>Textbooks<br>Projector<br>MS Excel<br>LMS<br>E-Library<br>Computer System<br>Internet access | Create simple descriptive data analysis (frequency, mean, median, mode, min, max, cross tabulation, variance, standard deviation)<br><br>Create simple charts using excel/Python (Matplotlib, Seaborn).<br><br>Modify visualization elements (titles, labels, colors, legends).<br><br>Compare datasets using different visualization techniques. | 1. Demonstrate how to create descriptive data analysis (frequency, mean, median, mode, min, max, cross tabulation, variance, standard deviation) using excel<br><br>2. Conduct a hands-on visualizations using excel/Python.<br><br>3. Provide coding exercises where students create different charts.<br><br>4. Assign a mini-project where students visualize real-world data. | Jupyter notebook<br>Dataset<br>Matplotlib doc<br>Seaborn doc<br>Slides<br>MS Excel<br>LMS<br>E-Library<br>Computer System<br>Internet access |
| **GENERAL OBJECTIVE 3.0: Use CSV and JSON files** | | | | | | |
| 5-7 | 3.1 Describe the structure of CSV and JSON files.<br><br>3.2 Explain the differences between CSV and JSON | Describe the structure of CSV and JSON files.<br><br>Explain the differences between CSV and JSON | Slides<br>Videos<br>Textbooks<br>Projector<br>CSV & JSON datasets | Write CSV and JSON files using Pandas.<br><br>Convert data between CSV and | Guide students in reading and writing CSV and JSON files in Python.<br><br>Assign exercises | Slides<br>Jupyter notebook<br>Projector<br>CSV & JSON datasets |

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| | data formats.<br><br>3.3 Explain the purpose and usage of CSV and JSON files.<br><br>3.4 Describe common applications of CSV and JSON in AI and data science.<br><br>3.5 List the advantages and limitations of each format. | data formats.<br><br>Explain the purpose and usage of CSV and JSON files.<br><br>Explain common applications of CSV and JSON in AI and data science.<br><br>Discuss the advantages and limitations of each format | LMS<br>E-Library<br>Computer System<br>Internet access | JSON formats.<br><br>Perform basic operations on CSV/JSON data (filtering, sorting). | where students manipulate data in these formats.<br><br>Provide debugging challenges for common errors in file handling. | LMS<br>E-Library<br>Computer System<br>Internet access |
| **GENERAL OBJECTIVE 4.0: Visualize data with Matplotlib and Seaborn** | | | | | | |
| 8-10 | **4.1** Know how to install and import Matplotlib and Seaborn libraries in Python.<br><br>**4.2** Understand the basic structure of Matplotlib and Seaborn visualizations.<br><br>**4.3** Know how to create basic plots (e.g., line plots, bar charts, histograms) using Matplotlib.<br><br>**4.4** Know how to customize plots (e.g., adding labels, | **Explain the importance** of data visualization in analyzing data and making informed decisions. Show examples of how visualizations can help detect patterns, trends, and outliers in real-world scenarios (e.g., business, science, or economics).<br><br>**Explain** how to import the libraries in a Python program | Slides<br>Videos<br>Textbooks<br>Projector<br>Datasets repository<br>Jupyter notebooks<br>Python IDE<br>LMS | 1. Install Matplotlib and Seaborn.<br><br>2. Create different types of plots using Matplotlib and Seaborn.<br><br>3. Customize graphs with colors, labels, legends, and annotations.<br><br>Generate simple meaningful informative charts | 1. Demonstrate how to install and configure the Matplotlib and Seaborn platform<br><br>2. Conduct sample procedures on how to create different types of visualizations.<br><br>3. Assign practical exercises to modify and improve graphs.<br><br>4. Provide students with datasets and ask them to generate | Datasets repository<br>Jupyter notebooks<br>Python IDE<br>LMS<br>E-Library<br>Computer System<br>Internet access |

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| | titles, and legends) to enhance clarity and presentation.<br><br>**4.5** Know how to apply Seaborn to visualize trends and patterns in datasets.<br><br>**4.7** Know how to interpret and analyze data through visualizations, using both Matplotlib and Seaborn. | Explain how to create basic visualizations using Matplotlib, including line plots, bar charts, and histograms.<br><br>Explain how to customize their plots by adding labels, titles, and changing colors.<br><br>Introduce Seaborn and explain how it can be used for more advanced visualizations like box plots, heatmaps, and pair plots. | | using the given dataset | meaningful charts. | |
| **GENERAL OBJECTIVE 5.0: Perform simple data analysis techniques** | | | | | | |
| 11-12 | 5.1 Describe basic statistical measures (mean, median, mode, standard deviation).<br><br>5.2 Explain the importance of descriptive statistics in data analysis.<br><br>5.3 Describe trends and patterns in datasets. | Explain basic statistical measures (mean, median, mode, standard deviation).<br><br>Explain the importance of descriptive statistics in data analysis.<br><br>Discuss trends and patterns in datasets. | Slides<br>Videos<br>Textbooks<br>Projector<br>Datasets repository<br>Jupyter notebooks<br>Python IDE<br>LMS<br>E-Library<br>Computer System<br>Internet access | Calculate basic statistical measures using Python (Pandas, NumPy).<br><br>Analyze datasets to identify trends and patterns.<br><br>Generate summary statistics using Python. | Guide students to<br><br>Calculate basic statistical measures using Python (Pandas, NumPy).<br><br>Analyze datasets to identify trends and patterns.<br><br>Generate summary statistics using Python. | Jupyter notebook<br>Datasets<br>Numpy<br>Pandas<br>Datasets repository<br>Python IDE<br>LMS<br>E-Library<br>Computer System<br>Internet access |

| PROGRAMME: ARTIFICIAL INTELLIGENCE (AI) & MACHINE LEARNING (ML) CRAFT | | | | |
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| **MODULE 5: Introduction to Machine Learning and Deep Learning** | | | **COURSE CODE: CAI 235** | **CONTACT HOURS: 72** |
| **YEAR:** 2 | **TERM: 2** | **PRE: REQUISITE:** | **Theoretical:** 24 Hours<br>**Practical:** 48 Hours | |
| **GOAL:** This module is designed to equip the trainee with the knowledge and skills of fundamentals of machine learning and deep learning concepts to enable them build simple ML models. | | | | |

**GENERAL OBJECTIVES:**

On completion of this module, the trainee should be able to:

1.0 Understand Machine Learning

2.0Know types of Machine Learning (Supervised, Unsupervised, Reinforcement)

3.0 Understand Classification and Regression

4.0 Build a simple ML model

5.0 Evaluate model performance

6.0 Understand the concept of deep learning and its applications

7.0 Know the basics of neural networks and how neural networks learn from data.

8.0 Develop a simple deep learning model.

9.0 Understand the ethical implications and future of deep learning

10.0 Appreciate the difference between Machine Learning and Deep Learning

| **PROGRAMME: ARTIFICIAL INTELLIGENCE (AI) & MACHINE LEARNING (ML) CRAFT** | | | | | | |
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| **MODULE 5: Introduction to Machine Learning and Deep Learning** | | | | **COURSE CODE: CAI 235** | | **CONTACT HOURS:** |
| **YEAR:** 2 | **TERM:** 2 | **PRE: REQUISITE:** | | **Theoretical:** 20 Hours<br>**Practical:** 40 Hours | | |
| **GOAL:** This module is designed to equip the trainee with the knowledge and skills of fundamentals of machine learning and deepl learning concepts to enable them build simple ML models. | | | | | | |
| **Theoretical Content** | | | | **Practical Content** | | |
| **GENERAL OBJECTIVE 1.0: Understand Machine Learning** | | | | | | |
| **Week** | **Specific Learning Outcome** | **Teachers Activities** | **Learning Resources** | **Specific Learning Outcome** | **Teachers Activities** | **Learning Resources** |
| 1 | 1.1. Define machine learning and its significance in AI.<br><br>1.2. Differentiate between traditional programming and machine learning.<br><br>1.3. State real-world applications of machine learning.<br><br>1.4. State the impact of ML in (healthcare, finance, agriculture etc.). | Explain the concept of machine learning<br><br>Discuss traditional programming with machine learning<br><br>Discuss applications of machine learning.<br><br>Explain the impact of ML in (healthcare, finance, agriculture etc.). | Slides<br>Videos<br>Textbooks<br>Projector | Identify the impact of ML in (healthcare, finance, agriculture etc.). | Guide students to:<br>Identify the impact of ML in (healthcare, finance, agriculture etc.). | TensorFlow Playground<br>Google Colab,<br>Pre-trained Models |
| **GENERAL OBJECTIVE 2.0: Know types of Machine Learning (Supervised, Unsupervised, Reinforcement)** | | | | | | |
| 2 | 2.1. Describe the three main types of machine learning.<br><br>2.2. State key differences between supervised, unsupervised, and | Explain the three main types of ML with examples.<br><br>Discuss key differences between supervised, | Case studies<br>Textbooks<br>Internet<br>Slides | Identify real-world applications for each ML type in 2.2.<br><br>Implement a basic | Guide students to:<br><br>Identify real-world applications for each ML type in 2.2. | Jupyter notebook<br>Datasets<br>Python docs<br>Slides<br>Projector |

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| | reinforcement learning.<br><br>2.3. State real-world applications for each ML type in 2.2.<br><br>2,4 State the key Python libraries used in ML (Scikit-learn, Pandas, NumPy). | unsupervised, and reinforcement learning.<br><br>Discuss real-world applications for each ML type in 2..<br><br>Explain the key Python libraries used in ML (Scikit-learn, Pandas, NumPy). | | supervised and unsupervised learning example using Python.<br><br>Load a sample dataset and apply a simple clustering algorithm (e.g., k-means).<br><br>Train a basic classification model on labeled data. | Implement a basic supervised and unsupervised learning example using Python.<br><br>Load a sample dataset and apply a simple clustering algorithm (e.g., k-means).<br><br>Train a basic classification model on labeled data. | TensorFlow Playground Google Colab, Pre-trained Models |
| **GENERAL OBJECTIVE 3.0: Understand Classification and Regression** | | | | | | |
| 3 | 3.1. Define classification and regression in ML.<br><br>3.2. State the differences between classification and regression problems.<br><br>3.3. State real-world applications of classification and regression.<br><br>. | Explain the difference between classification and regression using examples.<br><br>Explain the differences between classification and regression problems.<br><br>Discuss real-world applications of classification and regression. | Case studies Textbooks Internet Slides TensorFlow Playground Google Colab, Pre-trained Models | Implement a simple classification model using Python (e.g., decision tree, logistic regression).<br><br>Implement a simple regression model (e.g., linear regression)<br><br>Analyze model predictions and interpret outputs. | 1. Guide students in coding a basic classification model using Scikit-learn.<br><br>2. Demonstrate how to implement a simple regression model.<br><br>Guide students to analyze model predictions and interpret outputs | Jupyter notebook Datasets Python IDE Slides Projector TensorFlow Playground Google Colab, Pre-trained Models |

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| **GENERAL OBJECTIVE 4.0: Build a simple ML model** | | | | | | |
| 4-5 | | | | Identify the steps involved in building an ML model.<br><br>Compute data before training a model.<br><br>Deploy a basic machine learning model. | Guide students through the end-to-end ML model building process.<br><br>Guide students to:<br><br>Compute data before training a model.<br><br>Deploy a basic machine learning model. | Datasets<br>Jupyter notebook<br>Python IDE<br>Slides<br>Projector<br>TensorFlow Playground<br>Google Colab,<br>Pre-trained Models |
| **GENERAL OBJECTIVE 5.0: Evaluate model performance** | | | | | | |
| 6 | 5.1. State the importance of model evaluation.<br><br>5.2. State different model evaluation metrics (accuracy, precision, recall, F1-score, mean squared error).<br><br>5.3. Explain overfitting and underfitting in ML models. | Explain different evaluation metrics and their significance.<br><br>Discuss real-world examples of model performance evaluation<br><br>Discuss how to handle overfitting and underfitting in ML models. | Case studies<br>Textbooks<br>Internet<br>Slides | 1. Evaluate a trained ML model using accuracy, precision, and recall.<br><br>2. Use confusion matrices to analyze classification model performance.<br><br>3. Optimize a model by adjusting hyperparameters and analyzing results. | 1. Guide students in using Scikit-learn to evaluate ML models.<br><br>2. Provide exercises where students compute evaluation metrics for different models.<br><br>3. Assign a mini-project where students build and evaluate a simple ML model. | Datasets<br>Jupyter notebook<br>Python IDE<br>TensorFlow Playground<br>Google Colab,<br>Pre-trained Models |

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| **GENERAL OBJECTIVE 6.0: Understand the concept of deep learning and its applications** | | | | | | |
| 7 | 6.1. Define the term Deep Learning<br><br>6.2. State Real-World Applications of Deep Learning.<br><br>6.3 Describe Image Classification model in Deep Learning | Explain the term Deep Learning<br><br>Discuss Real-World Applications of Deep Learning.<br><br>Explain the Image Classification model in Deep Learning | Case studies<br>Textbooks<br>Intenet<br>Slides<br>Projector | Develop Image Classification application in Deep Learning | Demonstrate Image Classification application in Deep Learning | Case studies<br>Textbooks<br>Internet<br>Slides<br>Projector<br>TensorFlow Playground<br>Google Colab,<br>Pre-trained Models |
| **GENERAL OBJECTIVE 7.0: Know the basics of neural networks and how neural networks learn from data** | | | | | | |
| 8 | 7.1. Define the term neural networks.<br><br>7.2. Explain the basic terms (Analogy, Layers and Neurons).<br><br>7.3. Identify the Math Behind Neural Networks<br><br>**7.4** State how neural networks learn from data | Explain the basics of neural networks.<br><br>Discuss the basic terms (Analogy, Layers and Neurons).<br><br>Explain the Math Behind Neural Networks.<br><br>Explain how neural networks learn from data | Case studies<br>Textbooks<br>Internet<br>Slides<br>Projector<br>TensorFlow Playground<br>Google Colab,<br>Pre-trained Models | **Develop simple** Neural Network<br><br>Train a simple model (e.g., MNIST handwritten digit classification) usin using Google Colab<br><br>Evaluate the model overfitting and Underfitting | Guide students in developing a Simple Neural Network.<br><br>Develop a guide to train simple model (e.g., MNIST handwritten digit classification) usin using Google Colab<br><br>Demonstrate to the students how model overfitting and Underfitting | Case studies<br>Textbooks<br>Internet<br>Projector<br>TensorFlow Playground<br>Google Colab,<br>Pre-trained Models |

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| **GENERAL OBJECTIVE 8.0: Develop a simple deep learning model** | | | | | | |
| 9-10 | | | | Demonstrate the competence with the development environment.<br><br>Execute working steps on creating simple Deep Learning Model.<br><br>Develop simple Deep learning. | Create guide to prepare the development environment for Deep Learning Model<br><br>Develop working steps on creating simple Deep Learning Model.<br><br>Demonstrate the basic process for development of Deep Learning and debug with the students. | Case studies<br>TensorFlow Playground<br>Google Colab,<br>Pre-trained Models |
| **GENERAL OBJECTIVE 9.0: Understand the ethical implications and future of deep learning** | | | | | | |
| 11 | 9.1. State the ethical implications Deep Learning<br><br>9.2. Identify the future trend of deep learning.<br><br>9.3 State career opportunities in the Deep Learning | 1. Discuss the ethical implications of Deep Learning<br><br>Explain the future of deep learning.<br><br>Discuss career opportunities in Deep Learning. | Case studies<br>Textbooks<br>Internet<br>Slides | | | |
| **GENERAL OBJECTIVE 10.0: Appreciate the difference between Machine Learning and Deep Learning** | | | | | | |
| 12 | 10.1. Identify the differences between Machine Learning | Explain the differences between Machine Learning Approach and | Case studies<br>Textbooks<br>Intenet | | | |

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| | Approach and Deep Learning Approach.<br><br>10.2. State the differences between Image Classification for both ML and DL.<br><br>10.3. Explain the Text Translation<br>a. Use statistical models (e.g., n-grams)<br>b. Use sequence-to-sequence models (e.g., LSTMs).. | Deep Learning Approach.<br><br>Explain the differences between Image Classification Use handcrafted features (e.g., edges, shapes) and Use convolutional neural networks (CNNs).<br><br>Contrast between The Text Translation<br>a. Use statistical models (e.g., n-grams)<br>b. Use sequence-to-sequence models (e.g., LSTMs). | Slides | | | |

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| **PROGRAMME: ARTIFICIAL INTELLIGENCE (AI) & MACHINE LEARNING (ML) CRAFT** | | | |
| **MODULE 6: Deep Learning Applications** | | **COURSE CODE: CAI 316** | **CONTACT HOURS: 72** |
| **YEAR:** 2 | **TERM: 3** | **PRE: REQUISITE:** | **Theoretical:** 24 Hours<br>**Practical:** 48 Hours |
| **GOAL:** This module is designed to provide trainees with the knowledge and skills of neural networks, deep learning techniques and its application for AI development | | | |

**GENERAL OBJECTIVES:**

On completion of this module, the trainee should be able to:

1.0 Understand the role of neural networks in deep learning

2.0 Implement activation functions and optimizations

3.0 Implement deep learning frameworks (Tensorflow, PyTorch)

4.0 Train developed simple neural networks in module 5: 8.3

5.0 Evaluate the developed image classification

| PROGRAMME: ARTIFICIAL INTELLIGENCE (AI) & MACHINE LEARNING (ML) CRAFT | | | | | | |
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| **MODULE 6: Deep Learning Applications** | | | | **COURSE CODE: CAI 316** | | **CONTACT HOURS: 72** |
| **YEAR: 2** | **TERM:** 3 | **PRE: REQUISITE:** | | **Theoretical:** 24 Hours<br>**Practical:** 48 Hours | | |
| **GOAL:** This module is designed to provide trainees with the knowledge and skills of neural networks, deep learning techniques and its application for AI development | | | | | | |
| **Theoretical Content** | | | | **Practical Content** | | |
| **GENERAL OBJECTIVE 1.0: Understand the concept of neural networks** | | | | | | |
| **Week** | **Specific Learning Outcome** | **Teachers Activities** | **Learning Resources** | **Specific Learning Outcome** | **Teachers Activities** | **Learning Resources** |
| 1-2 | 1.1. Explain the concept of artificial neural networks (ANNs).<br><br>1.2. Describe the structure of a neural network (input, hidden, and output layers).<br><br>1.3. State the role of weights, biases, and activation functions in neural networks.<br><br>14. State real-world applications of neural networks. | Explain the fundamental concepts of artificial neural networks using diagrams.<br><br>Use visualizations and animations to show how information flows through a neural network.<br><br>Discuss real-world applications of neural networks in AI.<br><br>Engage students in an interactive Q&A session on neural network structures. | Slides<br>Videos<br>Textbooks<br>Internet | Identify the role of weights, biases, and activation functions in neural networks.<br><br>Use visualizations and animations to show how information flows through a neural network. | Guide students to:<br><br>Identify the role of weights, biases, and activation functions in neural networks.<br><br>Use visualizations and animations to show how information flows through a neural network. | TensorFlow Playground<br>Google Colab,<br>Pre-trained Models |
| **GENERAL OBJECTIVE 2.0: Implement activation functions and optimizations** | | | | | | |
| 2-3 | 2.1. Define activation functions and their purpose | Explain activation functions with graphs and | Slides<br>Videos<br>Textbooks | Implement different activation functions in Python | Guide students in coding and visualizing | Jupyter notebook<br>Datasets |

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| | in neural networks.<br><br>2.2. Differentiate between common activation functions (ReLU, Sigmoid, Tanh, Softmax).<br><br>2.3. State the importance of optimization algorithms in deep learning.<br><br>2.4. Explain concepts like gradient descent, learning rate, and backpropagation. | real-world applications.<br><br>Discuss the importance of optimization in training deep learning models.<br><br>Explain key optimization algorithms like SGD, Adam, and RMSprop.<br><br>Discuss the concepts like gradient descent, learning rate, and backpropagation | Internet | using NumPy and Matplotlib.<br><br>Experiment with optimization techniques using small datasets.<br><br>Compare the impact of different activation functions on neural network performance. | activation functions.<br><br>Create exercises where students apply different optimization algorithms.<br><br>Conduct a comparative analysis of various activation functions in a simple neural network. | Python libraries |
| **GENERAL OBJECTIVE 3.0: Implement deep learning frameworks (Tensorflow, PyTorch)** | | | | | | |
| 4-5 | 3.1. Describe the role of deep learning frameworks in AI development.<br><br>3.2. Differentiate between TensorFlow and PyTorch.<br><br>3.3. State the core components of a deep learning framework (tensors, computational graphs, autograd). | Introduce TensorFlow and PyTorch with examples.<br><br>Discuss the advantages and use cases of each framework.<br><br>Explain computational graphs and automatic differentiation. | Slides<br>Internet<br>Books<br>Videos | Install TensorFlow and PyTorch on their systems.<br><br>Manipulate tensors using both frameworks.<br><br>Implement a simple computation graph using TensorFlow or PyTorch. | Guide students in installing and setting up TensorFlow and PyTorch.<br><br>Guide students to:<br><br>Create and manipulate tensors using both frameworks.<br><br>Implement a simple computation graph using TensorFlow or PyTorch. | Jupyter notebook<br>Code snippets<br>Python libraries |
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| **GENERAL OBJECTIVE 4.0: Train developed simple neural networks in module 5: 8.3** | | | | | | |
| 6-9 | Know the step-by-step process of training a neural network. | Explain the step-by-step process of training a neural network. | | Design a simple feedforward neural network.<br><br>Train a neural network using TensorFlow or PyTorch.<br><br>Adjust hyperparameters like learning rate, batch size, and number of epochs. | Guide students in building a simple neural network from scratch.<br><br>Create exercises where students modify hyperparameters and analyze their effects. | Jupyter notebook<br>Datasets<br>Python libraries |
| **GENERAL OBJECTIVE 5.0: Evaluate the developed image classification with neural networks** | | | | | | |
| 10-12 | Know the basics of convolutional neural networks (CNN) and their role in image classification. | Explain the basics of CNNs and their role in image classification. | | Implement an image classification model using CNNs.<br><br>Evaluate a CNN model on an image dataset.<br><br>Apply techniques like data augmentation to improve model performance.<br>Contrast the evaluation output | Demonstrate students through training an image classification model.<br><br>Create exercises on improving model performance using data augmentation and hyperparameter tuning.<br><br>Guide student to evaluate image classification output | Jupyter notebook<br>Datasets<br>Python libraries<br>Python IDE |

<table>
<tr><td colspan="4">PROGRAMME: ARTIFICIAL INTELLIGENCE (AI) & MACHINE LEARNING (ML) CRAFT</td></tr>
<tr><td colspan="2">MODULE 7: Applications of AI in Robotics and IoT</td><td>COURSE CODE: CAI 317</td><td>CONTACT HOURS: 72</td></tr>
<tr><td>YEAR: 3</td><td>TERM: 1</td><td>PRE: REQUISITE:</td><td>Theoretical: 24 Hours<br>Practical: 48 Hours</td></tr>
<tr><td colspan="4">GOAL: This module is designed to provide trainees with knowledge and skills of the integration of AI with robotics and IoT to enhance automation and smart systems.</td></tr>
<tr><td colspan="4">GENERAL OBJECTIVES:<br>On completion of this module, the trainee should be able to:<br>1. Understand AI integration in automation and robotics<br>2. Know machine learning integration in IoT<br>3. Demonstrate AI integration in embedded systems<br>4. Demonstrate sensor integration and data processing<br>5. Build a simple AI-powered IoT project</td></tr>
</table>

| PROGRAMME: ARTIFICIAL INTELLIGENCE (AI) & MACHINE LEARNING (ML) CRAFT | | | | | | |
|---|---|---|---|---|---|---|
| **MODULE 7: Applications of AI in Robotics and IoT** | | | | **COURSE CODE: CAI 317** | | **CONTACT HOURS: 72** |
| **YEAR:** 3 | **TERM:** 1 | **PRE: REQUISITE:** | | **Theoretical:** 24 Hours<br>**Practical:** 48 Hours | | |
| **GOAL:** This module is designed to provide trainees with knowledge and skills of the integration of AI with robotics and IoT to enhance automation and smart systems. | | | | | | |
| **Theoretical Content** | | | | **Practical Content** | | |
| **GENERAL OBJECTIVE 1.0: Understand AI integration in automation and robotics** | | | | | | |
| **Week** | **Specific Learning Outcome** | **Teachers Activities** | **Learning Resources** | **Specific Learning Outcome** | **Teachers Activities** | **Learning Resources** |
| 1-2 | 1.1. Define automation and robotics<br>1.2. Explain the relationship between robotics and AI.<br>1.3 State how AI enhances automation and robotics in real-world applications.<br>1.4. State key AI techniques used in robotics (e.g., computer vision, reinforcement learning, sensor fusion).<br>1.5. State ethical and societal implications of AI in robotics. | Explain the role of AI in automation and robotics using real-world examples.<br>Explain the relationship between robotics and AI.<br>Discuss how AI enhances automation and robotics in real-world applications.<br>Discuss key AI techniques used in robotics (e.g., computer vision, reinforcement learning | Slides<br>Videos<br>Textbooks<br>Journals | Analyze how AI-driven robots perceive and interact with their environment.<br>Simulate a simple AI-driven automation system.<br>Use AI models to control a basic robotic system (e.g., using Python and OpenCV for object detection). | Guide students through a simulation of an AI-driven robot performing a simple task.<br>Provide exercises where students analyze real-world AI applications in robotics.<br>Demonstrate object detection and path navigation in a virtual robotics simulator. | Jupyter notebook<br>AI tools (OpenCV, TensorFlow)<br>ROS |
| **GENERAL OBJECTIVE 2.0: Know machine learning integration in IoT** | | | | | | |
| 3-4 | 2.1. Describe how machine learning enhances IoT applications.<br>2.2. Differentiate between edge AI and cloud-based AI | Explain ML applications in IoT with real-world examples.<br>Compare edge computing vs. cloud-based ML | Slides<br>Videos<br>Textbooks<br>Journals | Implement a simple ML model for IoT data analysis.<br>Use Python to build a predictive model | Guide students through implementing a simple ML model for IoT.<br>Provide hands-on coding exercises for | Jupyter notebook<br>Datasets (sensor logs)<br>Python |

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| | for IoT.<br>2.3. Describe common ML techniques used in IoT (e.g., anomaly detection, predictive maintenance).<br>2.4 State challenges and security concerns in AI-powered IoT systems. | models.<br>Discuss common ML techniques used in IoT (e.g., anomaly detection, predictive maintenance<br>Discuss challenges and security concerns in AI-powered IoT systems. | | for an IoT dataset.<br>Deploy a basic ML model on an IoT device or a simulated environment. | predictive analytics in IoT.<br>Demonstrate how to deploy ML models on edge devices. | libraries<br>Python IDE |
| **GENERAL OBJECTIVE 3.0: Demonstrate AI integration in IoT and embedded systems** | | | | | | |
| 5-6 | 3.1. Define embedded systems and their role in AI and IoT.<br>3.2. State key components of an embedded system (microcontrollers, sensors, actuators).<br>3.3. State how AI models can be deployed on embedded systems. | Explain embedded system components using real-world examples.<br>Discuss AI use cases in embedded systems.<br>Compare different microcontrollers for AI-driven applications. | Slides<br>Textbooks<br>Videos<br>Journals | Program a microcontroller (Arduino, Raspberry Pi) for basic automation.<br>Interface sensors and actuators with an embedded system.<br>Deploy a simple AI model on an embedded device. | Guide students through setting up and programming an embedded device.<br>Guide students on sensor integration.<br>Demonstrate deploying a lightweight AI model on an embedded board. | Raspberry Pi<br>ESP32<br>Arduino<br>Arduino IDE |

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| **GENERAL OBJECTIVE 4.0: Demonstrate sensor integration and data processing** | | | | | | |
| 7-9 | | | | Interface different types of sensors (temperature, motion, image, etc.) with an embedded system.<br>Collect & preprocess sensor data for AI applications.<br>Implement real-time data processing techniques. | Guide students in connecting and testing different sensors.<br>Guide students in collecting and analyzing sensor data.<br>Demonstrate how to preprocess IoT sensor data for AI applications. | Ultrasonic sensors<br>Motion sensor<br>Arduino IDE<br>Python IDE<br>Pandas<br>Numpy |
| **GENERAL OBJECTIVE 5.0: Build a simple AI-powered IoT project** | | | | | | |
| 10-12 | | | | Design & implement a small AI-powered IoT project.<br>Integrate sensors, microcontrollers, and AI models into a working prototype.<br>Analyze and improve the performance of their IoT-based AI application. | Guide students to:<br>Design & implement a small AI-powered IoT project.<br>Integrate sensors, microcontrollers, and AI models into a working prototype.<br>Analyze and improve the performance of their IoT-based AI application. | Raspberry Pi<br>ESP32<br>Arduino<br>Arduino IDE |

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| **PROGRAMME: ARTIFICIAL INTELLIGENCE (AI) & MACHINE LEARNING (ML) CRAFT** | | | | |
| **MODULE 8: AI Ethics and Governance** | | | **COURSE CODE: CAI 318** | **CONTACT HOURS: 48** |
| **YEAR:** 3 | **TERM: 2** | **PRE: REQUISITE:** | **Theoretical:** 36 Hours<br>**Practical:** 12 Hours | |
| **GOAL:** This module is designed to provide students with the knowledge and skills of ethical considerations, biases in AI. | | | | |
| **GENERAL OBJECTIVES:**<br>On completion of this module, the trainee should be able to:<br>1.0 Understand bias and fairness in AI<br>2.0Understand AI and privacy concerns<br>3.0 Understand societal impact of AI<br>4.0 Understand regulations and policies for AI development<br>5.0 Explore the future of AI and career opportunities | | | | |

| **PROGRAMME: ARTIFICIAL INTELLIGENCE (AI) & MACHINE LEARNING (ML) CRAFT** | | | | | | |
|---|---|---|---|---|---|---|
| **MODULE 8: AI Ethics and Governance** | | | | **COURSE CODE: CAI 338** | | **CONTACT HOURS: 48** |
| **YEAR:** 3 | **TERM:** 2 | **PRE: REQUISITE:** | | **Theoretical:** 36 Hours<br>**Practical:** 12 Hours | | |
| **GOAL:** This module is designed to provide students with the knowledge and skills of ethical considerations, biases in AI. | | | | | | |
| **Theoretical Content** | | | | **Practical Content** | | |
| **GENERAL OBJECTIVE 1.0: Understand bias and fairness in AI** | | | | | | |
| **Week** | **Specific Learning Outcome** | **Teachers Activities** | **Learning Resources** | **Specific Learning Outcome** | **Teachers Activities** | **Learning Resources** |
| 1-2 | 1.1 Explain bias in AI and how it occurs.<br><br>1.2 State sources of bias in datasets and AI models.<br><br>1.3 Explain fairness in AI decision-making and why it is important.<br><br>1.4. Explain real-world cases of biased AI models. | Explain bias in AI and how it occurs.<br><br>Explain sources of bias in datasets and AI models.<br><br>Explain fairness in AI decision-making and why it is important.<br><br>Explain real-world cases of biased AI models | Slides<br>Textbooks<br>Journals<br>Videos | 1. Detect bias in an AI dataset using Python.<br><br>2. Implement bias mitigation techniques such as data balancing and reweighting.<br><br>3. Evaluate fairness in AI models using fairness metrics. | 1. Guide students through analyzing an AI dataset for bias.<br><br>2. Demonstrate bias mitigation techniques using Python.<br><br>3. Provide hands-on exercises for evaluating AI fairness. | Jupyter notebook<br>Datasets<br>Python libraries |
| **GENERAL OBJECTIVE 2.0: Understand AI and privacy concerns** | | | | | | |
| 2-4 | 2.1 Define AI privacy concerns and its risks<br><br>2.2 Explain how AI models handle personal data.<br><br>2.3 Explain concepts such as data anonymization and | 1. Explain how AI processes personal data and associated risks.<br><br>2. Discuss real-world privacy breaches involving AI. | Research articles<br>Journals<br>NDPR guidelines<br>Textbooks | 1. Implement basic privacy-preserving techniques in AI.<br><br>2. Apply data anonymization methods on a | 1. Guide students in implementing privacy-preserving techniques.<br><br>2. Demonstrate how anonymization affects AI model | Jupyter notebook<br>Datasets<br>Python libraries |

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| | differential privacy.<br><br>2.4 State legal and ethical considerations of AI and privacy. | Discuss legal and ethical considerations of AI and privacy. | | dataset. | performance. | |
| **GENERAL OBJECTIVE 3.0: Understand societal impact of AI** | | | | | | |
| 5-6 | 3.1 State the positive and negative impacts of AI on society.<br><br>3.2. State AI's role in automation, employment, and digital divide issues.<br><br>3.3 Explain ethical dilemmas in AI adoption and deployment. | 1. Explain AI's societal implications with real-world examples.<br><br>Explain AI's role in automation, employment, and digital divide issues.<br><br>Discuss ethical dilemmas in AI adoption and deployment. | AI articles & ethics documentary<br>Internet<br>Textbook | | | |
| **GENERAL OBJECTIVE 4.0: Understand regulations and policies for AI development** | | | | | | |
| 7-9 | 4.1 State existing AI regulations and frameworks.<br><br>4.2 Explain the importance of AI policies in preventing unethical AI use.<br><br>4.3 Compare global AI policies (EU AI Act, US AI Bill of Rights, China's AI regulations). | Explain different AI regulations and their impact on AI development.<br><br>Explain the importance of AI policies in preventing unethical AI use.<br><br>Discuss global AI policies (EU AI Act, US AI Bill of Rights, | Official policy docs<br>Official reports<br>Textbooks<br>Slides | | | |

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| | 4.4 State the role of government and organizations in AI governance. | China's AI regulations).<br><br>Explain the role of government and organizations in AI governance. | | | | |
| **GENERAL OBJECTIVE 5.0: Explore the future of AI and career opportunities** | | | | | | |
| 10-12 | 5.1 List emerging trends in AI and its future impact on industries.<br><br>2. Identify key career paths in AI ethics, fairness, and responsible AI.<br><br>3. State skills and certifications required for AI-related careers. | Provide an overview of emerging AI trends.<br><br>2. Discuss career paths in AI ethics, governance, and research.<br><br>3. Invite guest speakers working in AI governance or responsible AI roles. | Slides<br>Internet<br>Career guides for AI professionals | | | |

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| **PROGRAMME: ARTIFICIAL INTELLIGENCE (AI) & MACHINE LEARNING (ML) CRAFT** | | | | |
| **MODULE 9: AI Capstone Project** | | | **COURSE CODE: CAI 339** | **CONTACT HOURS: 72** |
| **YEAR:** 3 | **TERM: 3** | **PRE: REQUISITE:** | **Theoretical:** 12 Hours<br>**Practical: 6**0 Hours | |
| **GOAL:** This unit is designed to equip students with the knowledge and skills to apply AI techniques in solving a real-world problem | | | | |

**GENERAL OBJECTIVES:**

On completion of this module, the trainee should be able to:

1. Know problem statement
2. Perform data collection and preprocessing
3. Perform model selection and training
4. Perform model testing and evaluation

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| **PROGRAMME: ARTIFICIAL INTELLIGENCE (AI) & MACHINE LEARNING (ML) CRAFT** | | | | | | |
| **MODULE 9: AI Capstone Project** | | | | **COURSE CODE: CAI 339** | | **CONTACT HOURS: 72** |
| **YEAR:** 3 | **TERM:** 3 | **PRE: REQUISITE:** | | **Theoretical: 12** Hours<br>**Practical: 60** Hours | | |
| **GOAL:** This unit is designed to equip students with the knowledge and skills to apply AI techniques in solving a real-world problem | | | | | | |
| **Theoretical Content** | | | | **Practical Content** | | |
| **GENERAL OBJECTIVE 1.0: Define a problem statement** | | | | | | |
| **Week** | **Specific Learning Outcome** | **Teachers Activities** | **Learning Resources** | **Specific Learning Outcome** | **Teachers Activities** | **Learning Resources** |
| 1-2 | 1.1 State how to identify a real-world problem that can be solved using AI.<br><br>1.2 State how to formulate a clear, concise, and feasible AI problem statement.<br><br>1.3 Define objectives and expected outcomes for their AI project. | Explain how to select an AI problem using real-world examples.<br><br>Discuss how to formulate a clear, concise, and feasible AI problem statement.<br><br>Explain objectives and expected outcomes for their AI project. | AI case studies<br>Research papers<br>Journals<br>Slides<br>Videos<br>Textbooks | Develop a well-defined AI project proposal.<br><br>Present their chosen problem and justify its relevance<br><br>.<br>Conduct preliminary research to validate the problem's significance | Guide students to:<br><br>Critique each other's proposals.<br><br>Refine their problem statements based on feedback. | AI proposal template<br>Powerpoint/ Google slides |
| **GENERAL OBJECTIVE 2.0: Perform data collection and preprocessing** | | | | | | |
| 3-5 | | | | Collect relevant datasets for their AI projects.<br><br>Preprocess data to remove inconsistencies, missing values, and | 1. Demonstrate data collection from different sources (web scraping, APIs, public datasets).<br><br>2. Guide students in preprocessing | Datasets<br>Python IDE<br>Python libraries<br>Videos |

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| | | | | outliers.<br><br>Normalize and transform data for model training.<br><br>4. Document the data collection process, including sources and preprocessing techniques. | techniques such as handling missing values and feature scaling..<br><br>4. Provide feedback on students' data preprocessing documentation. | |
| **GENERAL OBJECTIVE 3.0: Perform model selection and training** | | | | | | |
| 6-9 | | | | 1. Choose an appropriate machine learning model based on their problem type.<br><br>2. Train a model using their pre-processed dataset.<br><br>3. Apply hyperparameter tuning to improve model performance.<br><br>4. Implement basic feature engineering techniques. | Guide students to choose an appropriate machine learning model based on their problem type.<br><br>2. Provide a step-by-step demonstration of model training.<br><br>3. Assign tasks where students train different models and compare results.<br><br>4. Guide students through hyperparameter tuning experiments. | Jupyter notebook<br>Python libraries<br>Videos |

| GENERAL OBJECTIVE 4.0: Perform model testing and evaluation | | | | | | |
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| 10-12 | | | | Evaluate trained model using appropriate metrics (e.g., accuracy, precision, recall, F1-score).<br><br>Interpret confusion matrices and other performance reports.<br><br>Test model on unseen data to assess generalizability.<br><br>Mitigate overfitting and underfitting issues | Guide students to interpret model evaluation metrics.<br><br>Demonstrate model validation techniques (cross-validation, test splits).<br><br>Assign hands-on exercises where students evaluate their models.<br><br>Provide feedback on students' model performance analysis. | Jupyter notebook<br>Python libraries |

**NTC Artificial Intelligence & Machine Learning Craft**

**Hardware Requirements**

| SN | Tools/Equipment | Quantity (for 60 students) |
|---|---|---|
| 1 | Laptops (High-performance for AI/ML) | 60 |
| 2 | Desktops (Alternative to laptops) | 60 |
| 3 | External Storage (HDD/SSD) | 10 (shared) |
| 4 | Keyboards & Mouse | 60 each |
| 5 | Monitors (for desktops) | 60 |
| 6 | Scientific Calculators | 60 |
| 7 | Projector | 1 |
| 8 | Graphing Tools (Physical or Digital Tablets) | 10 (shared) |
| 9 | Data Collection Kits | 10 (shared) |
| 10 | Sensors (IoT devices) | 20 (shared) |
| 11 | High-performance GPUs (CUDA-enabled) | 10 (shared servers) |
| 12 | Neural Network Accelerator Hardware (TPUs) | 5 (shared) |
| 13 | Smart Board | 2 |

**Software Requirements**

| S/N | Category | Software |
|---|---|---|
| 1 | Operating Systems | Windows, Linux (Ubuntu), macOS |
| 2 | Programming | Python, Jupyter Notebook, VS Code, PyCharm |
| 3 | Mathematics for AI | MATLAB, Wolfram Alpha, NumPy, Pandas |
| 4 | Data Handling | Excel, Google Sheets, Pandas, Matplotlib, Seaborn |
| 5 | Machine Learning | TensorFlow, PyTorch, Scikit-learn, Google Colab, OpenCV |
| 6 | Deep Learning | Keras, TensorFlow, PyTorch |
| 7 | Robotics & IoT | ROS (Robot Operating System), OpenCV |
| 8 | AI Ethics | AI Policy Documents, Ethical AI Guidelines |
| | Others | Raspberry Pi, ESP32, Arduino IDE, Ultrasonic sensors, Motion sensor, Pre-trained Models |
| 9 | Capstone Projects | PowerPoint, Google Slides, Project Management Tools |

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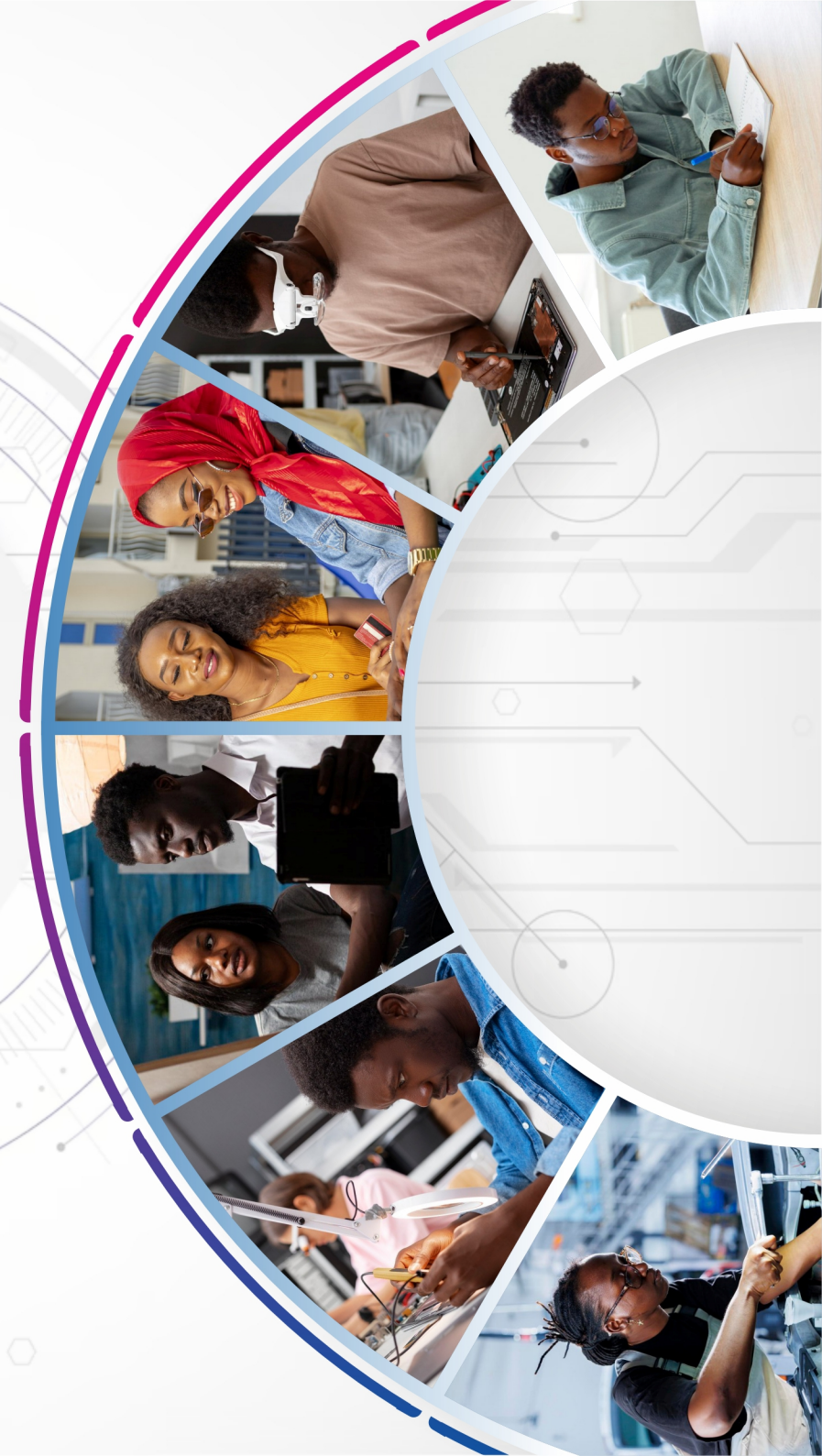

World Bank – National Board
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