NATIONAL BOARD FOR TECHNICAL EDUCATION

HIGHER NATIONAL DIPLOMA (HND)

ARTIFICIAL INTELLIGENCE (AI)

CURRICULUM AND COURSE SPECIFICATIONS

August, 2023

PLOT B, BIDA ROAD, P.M.B. 2239, KADUNA – NIGERIA

www.nbte.gov.ng

Foreword

The Higher National Diploma (HND) Artificial Intelligence Curriculum is designed to be used by training institutions to produce manpower to boost the practice of Artificial Intelligence in Nigeria.

Given that Artificial Intelligence is an emerging area in Nigeria, there is acute shortage of professionally-trained manpower in this sector. There is therefore the need to produce professional practitioners with good ethics and prospects for career progression, through the acquisition of desirable knowledge and skills. This necessitated the production of this National Curriculum.

It is my belief that this curriculum and course specifications, which is the minimum required to produce technologists with sound knowledge and skills in Artificial Intelligence, if properly implemented with the required resources along with qualified candidates being admitted into the programme, will lead to the production of competent and skilled technologists who will anchor the Design and Deployment of Artificial Intelligence Models for enhanced foreign exchange earnings.

I sincerely appreciate all those who made the development of this Curriculum possible. The invaluable contributions of all the members of the committee and resource persons during the pre-critique and National critique workshops are appreciated.

I hope that the Curriculum would be properly implemented so as to produce the required Work Force of our dream.

Prof. Idris M. Bugaje
Executive Secretary,
NBTE, Kaduna

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GENERAL INFORMATION

1.0   TITLE OF THE PROGRAMME:

Higher National Diploma Artificial Intelligence (AI)

2.0   GOAL AND OBJECTIVES:

2.1   GOAL: To enable students to create technology that allows computers and machines to work independently and intelligently.

2.2   OBJECTIVES OF THE PROGRAMME
A diplomate of HND Artificial Intelligence (AI) should be able to:

i.   Partake in AI project planning and solution design
ii.   Develop a system that process natural language
iii.   Develop algorithms for solving different problems
iv.   Innovate solutions to societal problems
v.   Apply AI techniques to solve complex problems across various industries
vi.   Implement algorithms that generate intelligent behavior on a Robot
vii.   Use appropriate methods to describe and analyse the performance of algorithms and system components
viii. Create synergy between AI and Humans
ix.   Set up and manage a business.

3.0   ENTRY REQUIREMENTS
The general entry requirements for the HND Artificial Intelligence (AI) Programme are:
(a) In addition to the entry requirement for National Diploma.
(b) ND Computer Science or Nigerian Skills Qualification (NSQ) levels 3-5
(C) One (1) year relevant industrial training

(d) ND diplomats with a pass (CGPA of 2.0-2.49) in the ND examination with two or more years of cognate experience in the specific field may be considered.

4.*0*   ***CURRICULLUM***

   4.1 The curriculum of the HND programme consists of four main components. These are:
   - I. General studies/education
   - II.   Foundation courses
   - III.   Professional courses

   4.2 The General Education component shall include courses in
   English Language
   Communication
   Mathematics
   Citizenship (the Nigerian Constitution),
   Entrepreneurship

   4.3 The General Education component shall account for not more than 15% of total contact hours for the programme.

   4.4 **Foundation Courses** include courses in Mathematics, and Statistics etc. The number of hours will vary with the programmes and may account for about 10 –15% of the total contact hours.

   4.5 **Professional Courses** are courses, which give the student the theory and practical skills he needs to practice his field of calling at the technical/technologists level.

5.0 STRUCTURE OF PROGRAMME

This is a two-year Programme i.e. four semesters of classroom, laboratory, field and workshop activities in the institution. Each semester shall be of 17 weeks duration made up as follows: 15 Contact weeks of teaching, i.e. recitation, practical exercises, quiz, tests, etc and 2 weeks for examination and registration.

6.0   EVALUATION SCHEME

The HND AI Examination must be externally moderated. In grading the students, theory shall constitute 40% while practical and project are 60% respectively.

7.0   ACCREDITATION

Each Programme offered at the HND level shall be accredited by the NBTE before the Diplomates can be awarded the Higher National Diploma certificates. Details about the process of accrediting a Programme for the award of the HND are available from the Executive Secretary, National Board for Technical Education, Plot B, Bida Road, P.M.B. 2239, Kaduna, Nigeria.

8.0   CONDITIONS FOR THE AWARD OF HND ARTIFICIAL INTELLIGENCE (AI)

Institutions offering this Programme will award the HND certificate to candidates who successfully completed the Programme after passing prescribed course work, examinations, Project and must have been certified by ICT industrial organization as recognized by NBTE. Such candidates should have completed a minimum of 76 to 80 credit units.

A candidate with Recognition of Prior Learning (RPL) equivalent and NSQ can proceed to graduate upon achieving the required credit units specified above.

8.1   GRADING OF COURSES: Courses shall be graded as follows:

MARKED RANGE	LETTER GRADE	WEIGHTING
75% and above	A	4.00
70% – 74%	AB	3.50
65% – 69%	B	3.25
60% – 64%	BC	3.00
55% – 59%	C	2.75
50% – 54%	CD	2.50
45% – 49%	D	2.25
40% – 44%	E	2.00

8.2 CLASSIFICATION OF DIPLOMAS: Higher National Diploma Certificates shall be awarded based on the following classifications:

Distinction	-	CGPA 3.50-4.00
Upper Credit	-	CGPA 3.00-3.49
Lower Credit	-	CGPA 2.50-2.99
Pass	-	CGPA 2.00-2.49

9.0   QUALIFICATION OF TEACHERS:

9.1   Holders of B.Sc/HND qualifications in Computer Science related disciplines.

9.2   In addition, teachers of this programme should have been trained and certified by recognized industrial bodies in AI or posseses higher degree or its equivalent in AI related discipline.

10.0   GUIDANCE NOTES FOR TEACHERS OF THE PROGRAMME

10.1   The new curriculum is drawn in unit courses. This is in keeping with the provisions of the National Policy on Education which stresses the need to introduce the semester credit units which will enable a student who so wish to transfer the units already completed in an institution of similar standard from which he is transferring.

10.2   As the success of the credit unit system depends on the articulation of programmes between the institutions and industry, the curriculum content has been written in behavioral objectives, so that it is clear to all the expected performance of the student who successfully completed some of the courses or the diplomats of the programme. There is a slight departure in the presentation of the performance-based curriculum which requires the conditions under which the performance is expected to be carried out and the criteria for the acceptable levels of performance. It is a deliberate attempt to further involve the staff of the department teaching the programme to write their own curriculum stating the conditions existing in their institution under which the performance can take place and to follow that with the criteria for determining an acceptable level of performance.

10.3   The Academic Board of the institution may vet departmental submission on the final curriculum. Our aim is to continue to see to it that a solid internal evaluation system exists in each institution for ensuring minimum standard and quality of education in the programmes offered throughout the Technical and Vocational Education (TVE) system. The teaching of the theory and practical work should, as much as possible, be

integrated. Practical exercises, especially those in professional courses and laboratory work should not be taught in isolation from the theory. For each course, there should be a balance of theory to practical in the ratio of 30:70.

11.0 Mandatory Skills Qualification

CURRICULUM TABLE
YEAR I SEMESTER I

S/N	COURSE CODE	COURSE TITLE	L	P	CU	CH
1	AIT 311	Computer Architecture	2	2	3	4
2	AIT 312	Python Programming Language	2	4	4	6
3	AIT 313	Artificial Intelligence	2	2	3	4
4	AIT 314	Theories of Computation and Algorithm	2	2	3	4
5	AIT 315	Mathematics and Statistics for AI	2	2	3	4
6	AIT 316	Ethical and Professional Practice in AI	2	0	2	2
7	GNS 301	Use of English III	2	0	2	2
Total			**14**	**12**	**20**	**26**

YEAR I SEMESTER II

S/N	COURSE CODE	COURSE TITLE	L	P	CU	CH
1	AIT 321	Machine Learning	2	2	3	4
2	AIT 322	Computer Vision	2	2	3	4
3	AIT 323	Data Science for AI	2	2	3	4
4	AIT 324	AI Development Framework	2	2	4	4
5	AIT 325	Neural Computation and Bioinformatics	2	2	3	4
6	AIT 326	Natural Language Processing	2	2	3	4
7	AIT 327	Research Methodology in Artificial Intelligence	2	2	2	4
8	AIT 328	Mandatory Skills Qualification I	0	4	4	4
9	ENT 326	Practice of Entrepreneurship I	2	2	2	4
10	GNS 302	Communication in English III	2	0	2	2
	Total		**18**	**20**	**29**	**38**

YEAR II SEMESTER I

S/N	COURSE CODE	COURSE TITLE	L	P	CU	CH
1	AIT 411	Seminar	2	0	2	2
2	AIT 412	Deep Learning	2	4	3	6
3	AIT 413	Soft and Quantum computing	2	2	3	4
4	AIT 414	AI Computing Solutions	2	4	4	6
5	AIT 415	AI Project Management	2	2	2	4
6	AIT 416	Mandatory Skills Qualification II	-	4	4	4
7	ENT 416	Practice of Entrepreneurship II	2	2	4	4
8	GNS 401	Communication in English IV	2	0	2	2
Total			**14**	**18**	**24**	**32**

YEAR II SEMESTER II

S/N	COURSE CODE	COURSE TITLE	L	P	CU	CH
1	AIT 421	Networks Security for AI	2	2	2	4
2	AIT 422	Robotics and Intelligent Systems	2	2	3	4
3	AIT 423	Web and Mobile Application Development	2	2	2	4
4	AIT 424	Project	-	6	6	6
	Total		**6**	**12**	**13**	**18**

YEAR ONE SEMESTER ONE COURSES

COMPUTER ARCHITECTURE

PROGRAMME: HIGHER NATIONAL DIPLOMA ARTIFICIAL INTELLIGENCE		
COURSE TITLE Computer Architecture	COURSE CODE: AIT 311	**Contact Hours:** 4 Hours/ Week
CREDIT UNITS: 3	PRE- REQUISITE: Nil	**Theoretical:** 2 Hours/Week
SEMESTER: ONE	**YEAR: ONE**	**Practical:** 2 Hours/Week
GOAL: This course is designed to enable students to acquire basic knowledge of Computer Organization		
General Objectives: On completion of the course, the student should be able to: 1.0 Understand Basic Computer Architecture Concepts 2.0 Comprehend Processor Performance 3.0 Design Digital Logic and Micro-architectural Level Components 4.0 Understand Different Types of Memory and Storage 5.0 Comprehend Instruction Level Parallelism 6.0 Understand Multiprocessors and Thread-Level Parallelism 7.0 Apply Knowledge to Real-world Situations		

PROGRAMME: HIGHER NATIONAL DIPLOMA ARTIFICIAL INTELLIGENCE					
COURSE: COMPUTER ARCHITECTURE		**COURSE CODE: AIT 311**		**Contact Hours:** 4 Hours/ Week	
CREDIT UNITS: 3		**PRE- REQUISITE: Nil**		**Theoretical:** 2 Hours/Week	
				Practical: 2 Hours/Week	
GOAL: This course is designed to provide the student with a thorough understanding of the key concepts and principles of computer architecture					
COURSE SPECIFICATION: Theoretical Contents:			**Practical Contents:**		
	General Objective: 1.0 Understand Basic Computer Architecture Concepts				
WEEK	**Specific Learning Outcomes**	**Teachers Activities**	**Learning Resources**	**Specific Learning Outcomes**	**Teachers Activities**	**Evaluation**
1-2	1.1 Explain the basic structure of a computer and its components 1.2 Explain how data flows within a computer system 1.3 Describe the functions of the main components of a computer system	Explain the basic structure of a computer and its components including the CPU, memory, and I/O devices. Explain how data flows within a computer system, including the concept of a bus, memory hierarchy, and I/O communication. Describe the role and functioning of the control unit, arithmetic	Marker board, Markers, Documentary films, Multimedia Projector and Screen, Case studies, Power point slides, Internet, Textbooks, Computer, Flip charts etc.	Disassemble and reassemble a computer system Trace the data flow within a computer system	Guide students to disassemble and reassemble a computer system to understand its components. Guide students to trace the data flow within a computer system during a specific	Explain the basic structure of a computer and its components including the CPU, memory, and I/O devices.

	1.4 Explain the basic concepts related to Instruction Set Architecture	logic unit, and registers within the CPU. Explain the basic concepts related to Instruction Set Architecture, including instruction types, formats, and addressing modes.		Write and execute a simple program to understand instruction types and formats.	operation or process. Guide students to write and execute simple programs to understand instruction types and formats.	
	1.5 Explain the principle of instruction pipelining and its impact on CPU performance.	Discuss the principle of instruction pipelining and its impact on CPU performance.				
General Objective:	**2.0** Comprehend Processor Performance.					
3-4	2.1 Explain the metrics used in measuring processor performance.	Explain the metrics used in measuring processor performance such as speed, power, and throughput.	Marker board, Markers, Documentary films, Multimedia Projector and Screen, Case studies, Power point slides, Internet, Textbooks, Computer, Flip charts etc.	Measure the speed, power, and throughput of a processor.	Guide students to measure the speed, power, and throughput of a processor.	Explain the metrics used in measuring processor performance such as speed, power, and throughput.
	2.2 Explain the factors affecting processor performance	Explain the factors affecting processor performance such as architecture design, clock speed, instruction set complexity, and parallel processing capabilities.		Run a processor benchmark on a computer system and interpret the results.	Guide students to run a processor benchmark on a computer	Explain the factors affecting processor performance

						system and interpreting the results.	such as architecture design, clock speed, instruction set complexity, and parallel processing capabilities.
	2.3 Explain the concept of processor benchmarking and the use of benchmarking software.	Discuss the concept of processor benchmarking and the use of benchmarking software.		Monitor and analyze the effects of cache memory and virtual memory on processor performance.	Guide students to monitor and analyze the effects of cache memory and virtual memory on processor performance.		
	2.4 Explain the effects of cache memory and virtual memory on processor performance.	Describe the effects of cache memory and virtual memory on processor performance.					
	2.5 Explain current trends and future directions in processor performance and technology.	Discuss current trends and future directions in processor performance and technology.					Explain the concept of processor benchmarking and the use of benchmarking software.
General Objective 3.0: Design Digital Logic and Micro-architectural Level Components							
5-6	3.1 Explain the concept of digital logic	Discuss the concepts of digital logic design including Boolean algebra, gates, and combinational circuits.	Marker board, Markers, Documentary films, Multimedia Projector and Screen, Case studies, Power point slides, Internet, Textbooks,	Design and test simple sequential circuits.	Guide students to design and test simple sequential circuits.	Explain the concepts of digital logic design including Boolean algebra, gates, and combinational circuits.	
	3.2 Explain the design of sequential circuits	Describe the design of sequential circuits		Design a simple digital system	Guide students to		

	3.3 Explain simple digital systems using schematic diagrams and/or hardware description languages.

3.4 Explain the fundamentals of micro-architecture unit

3.5 Explain the considerations and constraints in digital system design | including flip-flops, counters, and registers.

Discuss simple digital systems using schematic diagrams and/or hardware description languages.

Discuss the fundamentals of micro-architecture including datapath and control unit design.

Discuss the considerations and constraints in digital system design such as speed, power, cost, and complexity. | Computer, Flip charts etc. | using schematic diagrams or hardware description languages

Design simple micro-architectural component. | design a simple digital system using schematic diagrams or hardware description languages.

Guide students design and simulate simple micro-architectural component. | Explain simple digital systems using schematic diagrams and/or hardware description languages |
| **General Objectives: 4.0** Understand Different Types of Memory and Storage | | | | | | |
| 7-9 | 4.1 Explain the hierarchy of different types of memory and storage devices | Discuss the hierarchy and characteristics of different types of memory and storage devices (RAM, ROM, Hard disk, SSD, Cache etc.). | Marker board, Markers, Documentary films Multimedia Projector and Screen, Case studie Power point slides, Internet, Textbooks | Use simulation software to visualize how data is stored and retrieved in different memory types. | Guide students to use simulation software to visualize how data is stored and retrieved in different | Explain how data is stored and retrieved in different memory types. |

	4.2 Explain the characteristics of different types of memory and storage devices	Discuss how data is stored and retrieved in different memory types.	Computer, Flip charts etc.		memory types.	
	4.3 Explain how data is stored and retrieved in different memory types.	Discuss performance differences among various types of memory and storage devices.		Use a computer system to explore the use of virtual memory.	Guide students to use a computer system to explore the use of virtual memory.	
	4.4 Explain the performance differences among various types of memory and storage devices.	Discuss the use of virtual memory in computer systems. Discuss the concept of memory management in operating systems.		Use operating system simulation software to explore memory management.	Guide students to use operating system simulation software to explore memory management.	
	4.5 Explain the use of virtual memory in computer systems.					
	4.6 Explain the concept of memory management in operating systems.					
	General Objective: 5.0 Comprehend Instruction Level Parallelism					
10-11	5.1 Explain the concept of Instruction Level	Explain the concept of Instruction Level	Marker board, Markers,	Use different techniques to	Guide students to	Explain the impact of ILP

	Parallelism (ILP) and its importance in increasing computing performance. 5.2 Explain hardware and software techniques used to increase ILP. 5.3 Explain the impact of ILP on pipeline performance. 5.4 Explain the concepts of out-of-order execution and speculative execution in the context of ILP. 5.5 Explain the implications of dependencies between instructions in the context of ILP.	Parallelism (ILP) and its importance in increasing computing performance. Discuss the hardware and software techniques used to increase ILP. Discuss the impact of ILP on pipeline performance. Describe the concepts of out-of-order execution and speculative execution in the context of ILP. Discuss the implications of dependencies between instructions in the context of ILP.	Documentary films, Multimedia Projector and Screen, Case studies, Power point slides, Internet, Textbooks, Computer, Flip charts etc.	increase ILP using simulation software. Use simulation software to explore the concepts of out-of-order execution and speculative execution	use different techniques to increase ILP using simulation software. Assist students to use simulation software to explore the concepts of out-of-order execution and speculative execution.	on pipeline performance. Describe the concepts of out-of-order execution and speculative execution in the context of ILP.
General Objective 6.0: Understand Multiprocessors and Thread-Level Parallelism						
12-13	6.1 Explain the basic concepts of multiprocessors and thread-level parallelism.	Discuss the basic concepts of multiprocessors and thread-level parallelism.	Marker board, Markers, Documentary films, Multimedia Projector and Screen, Case studies, Power point slides,	Use different architectures of multiprocessor systems, such as symmetric multiprocessing	Assist students to use different architectures of multiprocesso	Explain the basic concepts of multiprocessors and thread-level parallelism.

	6.2 Explain the different architectures of multiprocessor systems 6.3 Explain the importance of cache coherence and memory consistency in multiprocessor systems. 6.4 Explain the role of parallel programming, and how to exploit thread-level parallelism. 6.5 Explain the performance implications and scalability of multiprocessor systems.	Discuss the different architectures of multiprocessor systems, such as symmetric multiprocessing (SMP) and massively parallel processing (MPP). Discuss the importance of cache coherence and memory consistency in multiprocessor systems. Explain the role of parallel programming, and how to exploit thread-level parallelism. Discuss the performance implications and scalability of multiprocessor systems.	Internet, Textbooks, Computer, Flip charts etc.	(SMP) and massively parallel processing (MPP). Carry out parallel programming, and exploit thread-level parallelism.	r systems, such as symmetric multiprocessing (SMP) and massively parallel processing (MPP). Guide students to carry out parallel programming, and exploit thread-level parallelism.	Discuss the different architectures of multiprocessor systems, such as symmetric multiprocessing (SMP) and massively parallel processing (MPP). Explain the performance implications and scalability of multiprocessor systems.
General Objective 7.0 Apply Knowledge to Real-world Situations**.**						
14-15	7.1 Explain the requirements of a given use case or application. 7.2 Explain principles and theories in the design of computer systems to	Discuss the requirements of a given use case or application. Discuss principles and theories in the design of computer systems to	Marker board, Markers, Documentary films, Multimedia Projector and Screen, Case	Design computer systems using appropriate software tools based on specific use cases.	Guide students to design computer systems using appropriate software tools	Explain principles and theories in the design of computer systems to meet

meet the specified requirements. 7.3 Explain computer system performance, scalability, cost, and power consumption.	meet the specified requirements. Discuss computer system performance, scalability, cost, and power consumption.	studies, Power point slides, Internet, Textbooks, Computer, Flip charts etc.	Validate a designed system using appropriate techniques	based on specific use cases. Assist students to validate their system designs using specific techniques and tools.	the specified requirements.

Python Programming Language

PROGRAMME: HIGHER NATIONAL DIPLOMA ARTIFICIAL INTELLIGENCE		
COURSE TITLE: Python Programming Language	**Course Code: AIT 312**	**Contact Hours:** 6 Hours/ Week
CREDIT UNIT: 4	**PRE-REQUISITE: Nil**	**Theoretical:** 2 Hours/Week
SEMESTER: ONE	**YEAR: ONE**	**Practical:** 4 Hours/Week
GOAL: This course is designed to provide students with the knowledge and skills of Python programming for Artificial Intelligence		
General Objectives: On completion of the course, the student should be able to: 1.0 Understand Python Fundamentals 2.0 Understand Data Manipulation and Analysis 3.0 Comprehend AI Algorithms Implementation 4.0 Understand Python Object Oriented Programming (OOP) 5.0 Understand Python Data Visualization for AI 6.0 Apply real world AI Development Projects		

PROGRAMME: HIGHER NATIONAL DIPLOMA ARTIFICIAL INTELLIGENCE						
COURSE: Python Programming Language		**COURSE CODE: AIT 312**		**Contact Hours:** 6 Hours/ Week		
CREDIT UNITS: 4		**PRE- REQUISITE: Nil**		**Theoretical:** 2 Hours/Week		
				Practical: 4 Hours/Week		
GOAL: This course is designed to provide student with the knowledge and skills of python programming for Artificial Intelligence						
COURSE SPECIFICATION: Theoretical Contents:			**Practical Contents:**			
	General Objective: 1.0 Understand Python fundamentals					
WEEK	**Specific Learning Outcomes**	**Teachers Activities**	**Learning Resources**	**Specific Learning Outcomes**	**Teachers Activities**	**Evaluation**
1-3	1.1 Explain the main features of Python. 1.2 Explain Python Data Structures 1.3 Explain control structures such as conditional statements(if-else) and loops (for, while) 1.4 Explain the importance of organizing code and promoting reusability 1.5 Explain the concept of Object-Oriented Programming (OOP)	Explain the main features of Python. Explain Python Data Structures - Variables - Data types - Operators Discuss control structures: - Conditional Statements - Logical Statements Discuss the concept of Object-Oriented Programming (OOP) Explain the relevance of python programming to AI applications	PC and a multimedia projector. Python Interpreter White board.	Install python on a computer system Write a simple python program Demonstrate code organization and to aid reusability Analyse and debug common	Assist student to install Python on a computer system Guide students to write a simple python program Assist students to organize code to aid reusability Guide students to analyse and debug common errors in Python codes	Explain the importance of organizing code and promoting reusability

Week						
	1.6 Explain the relevance of python programming to AI applications	Explain AI algorithms in python such as: - Search algorithms - Heuristic methods - Optimization Techniques		errors in python codes		
	1.7 Explain AI algorithms in python			Carryout linear regression using python		
	1.8 Explain linear regression and decision trees using python	Explain linear regression and decision trees using python				
	1.9 Explain the concept of data pre-processing and feature engineering in python for AI applications	Explain the concept of data pre-processing and feature engineering in python for AI applications				
General Objectives: 2.0 Understand Data Manipulation and Analysis						
4-5	2.1 Explain data types and structures 2.2 Explain Data pre-processing 2.3 Explain Data Exploration 2.4 Explain Data Visualization	Discuss the various data types and structures: - Numerical - Categorical - Textual - Arrays - Lists - Data frames Discuss Data manipulation techniques: - Filtering	PC and a multimedia projector. Python Interpreter White board.	Perform data cleaning, handle missing values, and remove duplicates. Apply data transformation techniques like normalization and standardization	Guide students to perform data cleaning, handle missing values, and remove duplicates Guide students to apply data transformation techniques like normalization	Explain Data pre-processing

	2.5 Explain correlation and its implications in data analysis	- Sorting - Grouping operations			and standardization
	2.6 Explain Data manipulation techniques			Create data visualizations, including histograms, scatter plots, and bar charts.	Guide students to create data visualizations, including histograms, scatter plots, and bar charts.
	2.7 Explain methods of data analysis				
	2.8 Explain how to Interpret and communicate results			Interpret visualizations to draw meaningful conclusions from data.	Guide students to interpret visualizations to draw meaningful conclusions from data.
				Calculate Measures of central tendency Interpret Measures of central tendency	Guide students to calculate and interpret measures of central tendency such as mean, median and mode
				Apply filtering, sorting, and grouping	Guide students to apply data manipulation techniques

				operations on data. Use functions for data aggregation, merging, and reshaping. Perform data slicing and indexing to extract relevant information Perform hypothesis testing to draw inferences about data populations. Apply regression analysis to explore relationships between variables	Guide students to use functions for data aggregation, merging, and reshaping. Guide students to perform data slicing and indexing to extract relevant information Guide students to perform hypothesis testing to draw inferences about data populations. Guide students to apply regression analysis to explore relationships between variables	

				Use popular data analysis tools like Python's Pandas, R, or SQL.	Guide students to use popular data analysis tools like Python's Pandas, R, or SQL.	
				Utilize libraries for data manipulation, such as NumPy, Pandas, or dplyr.	Guide students to utilize libraries for data manipulation, such as NumPy, Pandas, or dplyr	
	General Objective 3.0: Comprehend AI Algorithms Implementation					
6-7	3.1 Define fundamental concepts in artificial intelligence 3.2 Differentiate between supervised, unsupervised, and reinforcement learning approaches 3.3 Explain linear regression 3.4 Explain decision trees 3.5 Explain support vector machines.	Discuss the fundamental concepts in artificial intelligence: - machine learning - deep learning - neural networks.	PC and a multimedia projector. Python Interpreter White board.	Use reinforcement learning algorithms, such as Q-learning. Apply techniques like cross-validation to estimate model generalization. Interpret the predictions and decisions made by AI models.	Guide students to use reinforcement learning algorithms Guide students to apply techniques like cross-validation to estimate model generalization. Guide students to interpret the predictions and	Explain support vector machines.

						decisions made by AI models.	
	3.6 Explain the working principles of basic neural network architectures, including feedforward neural networks and convolutional neural networks (CNNs). 3.7 Explain backpropagation for training neural networks. 3.8 Explain reinforcement learning and its applications in different domains.			Analyze model outputs to identify strengths, limitations, and potential biases Apply AI algorithms to solve real-world problems in diverse domains. Adapt and modify AI models to fit specific application requirements.	Guide students to analyze model outputs to identify strengths, limitations, and potential biases Guide students to apply AI algorithms to solve real-world problems in diverse domains. Guide students to adapt and modify AI models to fit specific application requirements.		
General Objectives: 4.0 Understand Python Object Oriented Programming (OOP)							
8-10	4.1 Define the principles of Object-Oriented Programming	Discuss the principles of Object-Oriented Programming, including classes, objects,	PC and a multimedia projector. Python Interpreter	Create classes and objects	Guide students to create classes and objects	Explain Functions and function parameters.	

	4.2 Explain the benefits and importance of using OOP in Python. 4.2 Explain data encapsulation 4.3 Explain Inheritance. 4.4 Explain Abstraction 4.5 Explain special methods 4.6 Customize the behavior of classes for specific operations 4.7 Explain Exception Handling in OOP 4.8 Explain design patterns 4.9 Explain organize code using OOP:	inheritance, and polymorphism. Discuss special methods (also known as dunder methods) like init, str, repr, etc. Explain how to customize the behavior of classes for specific operations, such as addition or comparison. Explain design patterns like Singleton, Factory, and Observer.	White board. Jupyter notebook Visual Studio code Anaconda Google colab	Use access modifiers (public, private, protected) to control access to class members. Encapsulate data and behavior within classes to enhance data integrity and security. Create class hierarchies and establish parent-child relationships using inheritance. Use method overriding and method overloading to	Guide students to use access modifiers (public, private, protected) to control access to class members. Guide students to encapsulate data and behavior within classes to enhance data integrity and security. Guide students to create class hierarchies and establish parent-child relationships using inheritance. Guide students to use method overriding and method overloading to	

				create versatile class behaviors.	create versatile class behaviors.	
				Apply abstract classes and interfaces to define blueprints for related classes.	Guide students to apply abstract classes and interfaces to define blueprints for related classes	
				Implement abstract methods to ensure consistent behavior	Guide students to implement abstract methods to ensure consistent behavior	
				Use exception handling techniques to manage errors in object-oriented code.	Guide students to use exception handling techniques to manage errors in object-oriented code.	
				Raise and catch exceptions to handle unexpected situations	Guide students to raise and catch exceptions to handle	

				unexpected situations		
				Implement design patterns to solve specific programming challenges	Guide students to Implement design patterns to solve specific programming challenges	
				Design modular and maintainable code structures using OOP principles.	Guide students to design modular and maintainable code structures using OOP principles.	
				Apply OOP concepts to build larger applications with clear separation of concerns	Guide students to apply OOP concepts to build larger applications with clear separation of concerns	
General Objective: 5.0: Understand Python Data Visualization for AI						
11-13	5.1 Explain the importance of data	Discuss the importance of data visualization in AI and data analysis.	PC and a multimedia projector.	Create basic visualizations like line plots, scatter plots, and	Guide students to create basic visualizations like line plots,	List different type of

	visualization in AI and data analysis. 5.2 Explain the principles of effective data visualization. 5.3 Explain 3D Data Visualization: 5.4 Explain how to use 3D plots to convey complex data patterns 5.5 Explain how to visualize machine Learning model performance:	Discuss the principles of effective data visualization, including choosing appropriate chart types and colors.	Python Interpreter White board.	bar charts using Matplotlib. Customize plot aesthetics, labels, and annotations for better data representation Use Seaborn library to generate statistical visualizations like distribution plots, box plots, and violin plots. Apply faceting and grouping techniques to analyze data patterns efficiently Create 3D visualizations of data using libraries like	scatter plots, and bar charts using Matplotlib. Guide students to customize plot aesthetics, labels, and annotations for better data representation Guide students to use Seaborn library to generate statistical visualizations like distribution plots, box plots, and violin plots. Guide students to apply faceting and grouping techniques to analyze data patterns Guide students to create 3D visualizations of data using	Instruction set Enumerate the merits and demerits of charts and diagram

				Matplotlib or Plotly.	libraries like Matplotlib or Plotly.	
				Compare and visualize model results to make informed decisions during model selection.	Guide students to compare and visualize model results to make informed decisions during model selection.	
General Objective 6.0: Apply real world AI Development Project						
14-15	6.1 Explain AI project requirements 6.2 Explain Data Acquisition and Preprocessing 6.3 Explain suitable machine learning or deep learning algorithms based on the project's problem domain and data characteristics. 6.4 Explain the strengths and weaknesses of different AI models for specific tasks. 6.5 Explain how to optimize AI models by tuning hyperparameters	Explain AI project requirements Explain Data Acquisition and Preprocessing Explain suitable machine learning or deep learning algorithms based on the project's problem domain and data characteristics. Explain the strengths and weaknesses of different AI models for specific tasks. Explain how to optimize AI models by tuning hyperparameters	PC and a multimedia projector. Python Interpreter White board.	Collect and preprocess data from various sources to prepare it for AI modeling. Handle data cleaning, missing values, and data transformations as needed for the project.	Guide students to collect and preprocess data from various sources to prepare it for AI modeling. Guide students to handle data cleaning, missing values, and data transformations as needed for the project.	Differentiate between Synchronous and Asynchronous Buses Explain different Bus Arbitrations

	6.6 Explain Ensemble methods 6.7 Explain how ensembles can help improve predictive accuracy and reduce overfitting. 6.8 Describe considerations for scalability, performance, and security 6.9 Explain how to monitor and maintain AI systems	Explain ensemble methods like bagging, boosting, or stacking Explain how ensembles can help improve predictive accuracy and reduce overfitting. Explain considerations for scalability, performance, and security Explain how to monitor and maintain AI systems		Evaluate model performance using appropriate metrics to ensure effectiveness Optimize AI models by tuning hyperparameters to achieve better performance. Use techniques like grid search or random search to find optimal parameter values. Apply ensemble methods like bagging, boosting, or stacking	Guide students to evaluate model performance using appropriate metrics to ensure effectiveness Guide students to optimize AI models by tuning hyperparameters to achieve better performance Guide students to use techniques like grid search or random search to find optimal parameter values. Guide students to apply ensemble methods like bagging,	

				boosting, or stacking	
				Interpret model predictions and analyze the factors contributing to AI model decisions.	Guide students to interpret model predictions and analyze the factors contributing to AI model decisions.
				Use techniques like feature importance and model interpretation methods to gain insights.	Guide students to use techniques like feature importance and model interpretation methods to gain insights.
				Implement monitoring solutions to track AI model performance in real-time.	Guide students to implement monitoring solutions to track AI model performance in real-time.

				Create a maintenance plan to address issues and ensure model performance over time	Guide students to create a maintenance plan to address issues and ensure model performance over time	

PROGRAMME: HIGHER NATIONAL DIPLOMA ARTIFICIAL INTELLIGENCE		
COURSE TITLE: Artificial Intelligence	**Course Code: AIT 313**	**Contact Hours:** 4 Hours/ Week
CREDIT UNITS: 3	**Pre-requisite:**	**Theoretical:** 2 Hours/Week
SEMESTER: TWO	**YEAR: ONE**	**Practical:** 2 Hours/Week
GOAL: This course is designed to provide students with a comprehensive understanding of AI its theoretical foundations, practical applications, and implications		
General Objectives: On completion of the course, the student should be able to: 1.0 Understand the foundational principles and concepts of AI. 2.0 Comprehend AI Algorithms and Techniques. 3.0 Explore the fundamentals of machine learning 4.0 Understand forms of learning 5.0 Comprehend Machine Learning Algorithms 6.0 Understand the Different Artificial Intelligent Agents 7.0 Understand concept of Deep Learning		

PROGRAMME: HIGHER NATIONAL DIPLOMA ARTIFICIAL INTELLIGENCE		
COURSE: Artificial Intelligence	**COURSE CODE: AIT 313**	**Contact Hours:** 4 Hours/ Week
CREDIT UNITS: 3	**PRE- REQUISITE: Nil**	**Theoretical:** 2 Hours/Week
		Practical: 2 Hours/Week

GOAL: This course is designed to provide students with a comprehensive understanding of AI its theoretical foundations, practical applications, and implications

COURSE SPECIFICATION: Theoretical Contents:		Practical Contents:			
General Objective 1.0: Understand the Fundamental Concept and Principles of AI					
WEEK	**Specific Learning Outcomes**	**Teachers Activities**	**Learning Resources**	**Specific Learning Outcomes**	**Teachers Activities**	**Evaluation**
1-2	1.1 Explain the concept of AI 1.2 Explain the principles of AI 1.3 Explain the history of AI 1.4 Explain the subfields of AI	Discuss the fundamental concept of AI: - Principles & Concept of AI - AI History & Definitions - Subfields of AI	White Board. multimedia Projector MATLAB, WEKA, SPSS, TANAGRA,			Explain the AI Origin, a Techniques, and subfields of AI
	General Objective 2.0: Comprehend AI Algorithms and Techniques.					
3-4	2.1 Explain formal language 2.2 Explain informal language 2.3 Explain AI Algorithms	Discuss AI Algorithms - Pattern recognition - Search algorithms - Knowledge representation, - Knowledge reasoning,	White Board. multimedia Projector MATLAB, WEKA, SPSS, TANAGRA,	Use interactive tools or animations to visually demonstrate how AI	Assist students to implement basic AI algorithms, such as search	Explain how to solve simple AI problem

				algorithms work.	algorithms (e.g., BFS, DFS), sorting algorithms, or simple machine learning algorithms (e.g., k-nearest neighbors)	
General Objective 3.0: Explore the fundamentals of machine learning						
5-6	3.1 Explain the concept of machine learning 3.2 Explain the types of machine learning 3.3 Explain the differences between the types of machine learning	Discuss machine learning and its types: - Supervised - Semi- Supervised - Unsupervised Distinguish between supervised, semi-supervised and unsupervised	Google Colab, Kaggle Kernels, or DataCamp. Scikit-learn, TensorFlow, and PyTorch	Use supervised, unsupervised, and reinforcement learning algorithms using popular libraries Apply machine learning techniques to analyze real-world datasets, make predictions, or perform clustering.	Guide students to use supervised, unsupervised and reinforcement learning algorithms using popular libraries Assist students to apply machine learning techniques in analyzing real-world datasets, make	Demonstrate how to determine specifications and create SRS documents?

						predictions, or perform clustering.	

General Objective: 4.0 Understand Forms of Learning							
7	4.1 Define Learning 4.2 Explain Forms of Learning 4.3 Explain the key characteristics and principles underlying different forms of learning	Discuss forms of learning: - (Decision Trees and the ID3 - Algorithm, - Statistical learning Discuss the key characteristics and principles underlying different forms of learning	White board, multi-media devices, WEKA, TANAGRA, 11ANTS, PROLOG, LISP, Etc.				Discuss learning and learning characteristics

General Objective: 5.0 Comprehend Machine Learning Algorithms							
8-10	5.1 Explain how to select appropriate machine learning algorithms 5.2 Explain different types of data characteristics 5.3 Explain the various types of machine learning algorithms 5.4 Explain the strengths and	Discuss different machine learning algorithms, discussing their working principles, strengths, and weaknesses. Discuss the suitability machine learning algorithms for different types of data and tasks Explain the various types of machine learning algorithms	Devices, Kaggle Datasets and Notebooks, Machine Learning Projects Scikit-learn or TensorFlow	Carry out Machine learning projects	Guide students to carry out machine learning projects where they must choose appropriate algorithms, preprocess data, and evaluate model performance	Explain different types of data characteristics

	weaknesses of different machine learning algorithms	- Classification - Regression, - Clustering Explain the strengths and weaknesses of different machine learning algorithms				
General Objective 6.0: Understand the Different Artificial Intelligence Agents						
11-13	6.1 Explain different types AI Agents. 6.2 Explain the structure of Intelligence agents. 6.3 Explain agent environment. 6.2 Explain Test Phases	Discuss the concept of Artificial Intelligence agents, their characteristics, and how they interact with the environment. Explain Test Phases: - Unit testing - Integration testing, - System testing, etc.	Devices, Kaggle Datasets and Notebooks, Machine Learning Projects Scikit-learn or TensorFlow	Simulate: - Agent - Agent Implementati on Projects - Agent Interactions. - Agent Behaviour Analysis	Guide students to draw up testing schedule and perform the testing accordingly	Evaluate students' AI agent projects based on their design, functionality, and performance in solving the designated problem
General Objective 7.0 Understand concept of Deep Learning						
14-15	7.1 Explain deep learning concept and architectures. 7.2 Explain the historical development and evolution of deep learning and its	Discuss concepts of deep learning, neural networks, and various architectures Explain the historical development and evolution of deep learning and its	Deep Learning Libraries Documentation Such as; TensorFlow and /or PyTorch	Design Deep learning projects	Assign practical projects where students develop deep learning models to	Evaluate students' AI agent projects based on their design, functionality, and performance in

	significance in the field of artificial intelligence 7.3 Explain the fundamental building blocks of deep neural networks, such as input layers, hidden layers, activation functions, and output layers	significance in the field of artificial intelligence Explain the fundamental building blocks of deep neural networks, - Input layers, - Hidden layers, - Activation functions - Output layers		Carry out Model Tuning and Optimization.	solve image recognition and natural language processing tasks. Challenge students to optimize model hyperparameters and improve model performance on various datasets	solving the designated problem

PROGRAMME: HIGHER NATIONAL DIPLOMA ARTIFICIAL INTELLIGENCE		
COURSE TITLE: Theories of Computation and Algorithm	**Course Code: AIT 314**	**Contact Hours:** 4 Hours/ Week
CREDIT UNIT: 3	**PRE-REQUISITE:**	**Theoretical:** 2 Hours/Week
SEMESTER: ONE	**YEAR: ONE**	**Practical:** 2 Hours/Week
GOAL: This course is designed to acquaint students with knowledge and skills in Theories of Computation and Algorithm		
General Objectives: On completion of the course, the student should be able to: 1.0 Understand mathematical models of computations 2.0 Understand automata theory, formal language theory, computability theory and complexity theory 3.0 Understand the connection between finite automata and regular language 4.0 Comprehend non-computability and undecidability issues 5.0 Understanding Fundamental Concepts of Algorithms Data Structures and Sorting Algorithms 6.0 Comprehend Algorithm Analysis and Complexity, Sorting, and Searching 7.0 Comprehend Symbol Tables and Search Trees, Graph Algorithms, Maximum Flow, Minimum Cut, and Tries 8.0 Comprehend Performing Substring Search, Regular Expression, and Data Compression		

PROGRAMME: HIGHER NATIONAL DIPLOMA ARTIFICIAL INTELLIGENCE						
COURSE: Theories of Computation and Algorithm		**COURSE CODE:** AIT 314		**Contact Hours:** 4 Hours/ Week		
CREDIT UNITS: 3		**PRE- REQUISITE: Nil**		**Theoretical:** 2 Hours/Week		
				Practical: 2 Hours/Week		
GOAL: This course is designed to acquaint students with the knowledge of computational theory and Algorithm						
COURSE SPECIFICATION: Theoretical Contents:			**Practical Contents:**			
General Objective: 1.0 Understand mathematical models of computations						
WEEK	**Specific Learning Outcomes**	**Teachers Activities**	**Learning Resources**	**Specific Learning Outcomes**	**Teachers Activities**	**Evaluation**
1-3	1.1 Explain mathematical models of computations 1.2 Define formal languages 1.3 Define automata model 1.5 Differentiate between formal language and automata model 1.5 Explain the concepts of regular expressions, context-free grammar, and recursively	Explain different formal languages and automata models (e.g., finite automata, pushdown automata, Turing machines). Explain the concepts of regular, context-free grammar, and recursively enumerable languages and their relationships.	Marker board, Markers, Documentary films, Multimedia Projector and Screen, Case studies, Power point slides, Internet, Textbooks, Computer, Flip charts etc.	Use visual aids, diagrams, and animations to explain the workings of finite automata, pushdown automata, and Turing machines.	Guide student to use visual aids, diagrams, and animations to explain the workings of finite automata, pushdown automata, and Turing machines. Guide students to	Define formal languages Define automata model Differentiate between formal language and automata model Explain the concepts of regular, context-free, and recursively

	1.6 Enumerate languages and their relationships.			Create automata for specific languages.	create automata for specific languages.	
General Objectives: 2.0: Understand automata theory, formal language theory, computability theory and complexity theory						
4-5	2.1 Explain the concepts of automata theory, 2.2 Explain formal language theory, 2.3 Explain computability theory 2.4 Explain complexity theory 2.5 Explain how to compare the computational capabilities of different automata models. 2.6 Explain context-free grammars to describe	Describe the concepts of automata theory, Discuss formal language theory, Discuss computability theory Discuss complexity theory Compare the computational capabilities of different automata models. Discuss context-free grammars to describe syntactic	Marker board, Markers, Documentary films, Multimedia Projector and Screen, Case studies, Power point slides, Internet, Textbooks, Computer, Flip charts etc.	Set automaton diagrams and ask them to Identify the type of automaton (e.g., finite automata, pushdown automata). Create a visual representation of different automata types using software tools.	Guide student to set of automaton diagrams and ask them to Identify the type of automaton (e.g., finite automata, pushdown automata). Guide students to create visual representation of different automata types using software tools.	Explain complexity theory

	syntactic structures of languages.	structures of languages.		Create automata for specific languages.	Guide students to create automata for specific languages.	
				Distinguish different types of automata (finite automata, pushdown automata, Turing machines	Guide student to distinguish different types of automata (finite automata, pushdown automata, Turing machines) and their capabilities in recognizing or generating languages.	
				Demonstrate how languages can be recognized by different automaton systems	Guide student to demonstrate how languages can be recognized by different	

				automaton systems		
				Analyze the expressive power of each model	Guide students to analyse the expressive power of each model.	
				Apply real-world computational capabilities of different automata models play a role	Engage students to apply real-world applications where the computational capabilities of different automata models play a role, such as in programming languages and natural language processing.	

General Objective 3.0: Understand the connection between finite automata and regular language						
6-7	3.1 Define finite automata

3.2 Explain the components of finite automata

3.4 Explain the regular languages

3.5 Explain the significance of the correspondence between finite automata and regular languages in computer science and formal language theory. | Define finite automata

Discuss the components of finite automata

Discuss the regular languages

Discuss the significance of the correspondence between finite automata and regular languages in computer science and formal language theory. | Marker board, Markers, Documentary films, Multimedia Projector and Screen, Case studies, Power point slides, Internet, Textbooks, Computer, Flip charts etc. | Design and draw finite automata that recognize each language. | Guide students to design and draw finite automata that recognize each language. | Define finite automata,

List the components of finite automata

Discuss the regular languages |
| **General Objectives: 4.0:** Comprehend non-computability and undecidability issues |||||||
| **8** | 4.1 Explain the concepts of non-computability and undecidability

4.2 Define the following terms:
- Computable
- Algorithm
- Decision problem | Explain the concepts of non-computability and undecidability.

Explain the following terms:
- Computable
- Algorithm
- Decision problem | Marker board, Markers, Documentary films, Multimedia Projector and Screen, Case studies, Power point slides, Internet, Textbooks, Computer Flip charts etc. | Use reduction proofs to establish undecidability | Guide students to use reduction proofs to establish undecidability.

Guide students | Explain the concepts of non-computability and undecidability |

						through reduction examples, such as reducing the halting problem to other problems.
	4.3 Explain the origins of non-computability and undecidability concepts	Discuss the origins of non-computability and undecidability concepts, including foundational work by figures such as Kurt Gödel and Alan Turing.				
	4.4 Explain famous undecidable problems	Explain with examples of famous undecidable problems, such as the halting problem and the Entscheidungs problem.				
General Objective: 5.0: Understand Fundamental Concepts of Algorithms Data Structures and Sorting Algorithms						
9-10	5.1 Define algorithm	Explain algorithm	**Textbooks:** Softwares: LeetCode, HackerRank Codecademy	Make a sandwich, solving a Rubik's cube	Guide students to make a sandwich, solving a Rubik's cube	Define algorithm
	5.2 Explain the role of algorithm in problem-solving.	Explain the role of algorithm in problem-solving.				Explain its role in computer science and problem-solving.
	5.3 Explain algorithms, data structures, and problem-solving techniques	Discuss algorithms, data structures, and problem-solving techniques	Curate video lectures or tutorials that cover the definition of	Create algorithmic art by specifying a sequence of	Guide students to create algorithmic	

			algorithms and their role. Platforms like *Khan Academy, Coursera*, *edX*, and *YouTube* offer relevant content.	steps to create patterns or designs using paper and colors.	art by specifying a sequence of steps to create patterns or designs using paper and colors.	Discuss its role in computer science and problem-solving.
	5.6 Explain algorithmic complexity.	Discuss algorithmic complexity, e.g Big O notation and time/space complexity analysis.				
	5.7 Explain the differences between algorithms, data structures, and problem-solving techniques	Discuss the differences between algorithms, data structures, and problem-solving techniques		Sort out different sorting (e.g., bubble sort, merge sort).	Guide students to sort out different sorting (e.g., bubble sort, merge sort).	
	5.8 Explain the impact of algorithmic complexity on efficiency	Discuss the impact of algorithmic complexity (time and space) on efficiency		Determine when and why to use different data structures (e.g., arrays, linked lists, trees)	Guide students determine when and why to use different data structures (e.g., arrays, linked lists, trees)	
				Use online algorithm	Guide student to use online	

				visualization tools to demonstrate how different algorithms work with specific data input	algorithm visualization tools to demonstrate how different algorithms work with specific data input	
				Interact with algorithm tools and observe the impact of algorithmic choices on efficiency.	Guide students to interact with algorithm tools and observe the impact of algorithmic choices on efficiency.	
General Objective 6.0: Perform Algorithm Analysis and Complexity, Sorting, and Searching						
11-12	6.1 Explain how to implement stack and queue data structures. 6.2 Explain elementary sorting algorithms	Discuss how to implement stack and queue data structures. Discuss elementary sorting algorithms (e.g., bubble sort, insertion sort,	Marker board, Markers, Documentary films, Multimedia Projector and Screen, Case studies, Power point slides, Internet, Textbooks,	Use advanced sorting algorithms, including merge sort, quicksort, and radix sorts.	Guide students to use advanced sorting algorithms, including merge sort, quicksort, and radix sorts.	Compare and contrast the efficiency of different sorting and searching algorithms.

		selection sort) and analyze their time complexity.	Computer, Flip charts etc.			Explain how to apply algorithm analysis to determine the most
	6.3 Explain the efficiency of different sorting and searching algorithms.	Discuss the efficiency of different sorting and searching algorithms.		Analyze the time and space complexity of algorithms using Big O notation.	Guide students to analyze the time and space complexity of algorithms using Big O notation.	appropriate algorithm for a given problem.
	6.4 Explain how to apply algorithm analysis to determine the most appropriate algorithm for a given problem.	Explain how to apply algorithm analysis to determine the most appropriate algorithm for a given problem.				
	General Objective 7.0: Comprehend Symbol Tables and Search Trees, Graph Algorithms, Maximum Flow, Minimum Cut, and Tries					
13-14	7.1 Explain elementary symbol tables. 7.2 Explain hash tables and balanced search trees	Discuss elementary symbol tables. Discuss hash tables, balanced search trees (e.g., AVL trees, Red-Black trees), and their applications.	Marker board, Markers, Documentary films, Multimedia Projector and Screen, Case studies, Power point slides, Internet, Textbooks, Computer Flip charts etc.	Create visual representation of symbol table data structures, such as arrays or linked lists.	Guide students to create visual representation of symbol table data structures, such as arrays or linked lists.	Explain hash tables and balanced search trees

	7.3 Explain time and space complexity of algorithms using Big O notation. 7.4 Explain the efficiency of different sorting and searching algorithms. 7.5 Explain how to apply algorithm analysis to determine the most appropriate algorithm for a given problem. 7.6 Explain the applications of hash tables, balanced search trees (e.g., AVL trees, Red-Black trees) 7.7 Explain the differences between directed and undirected graphs.	Discuss time and space complexity of algorithms using Big O notation. Discuss the efficiency of different sorting and searching algorithms. Discuss how to apply algorithm analysis to determine the most appropriate algorithm for a given problem. Discuss the applications of hash tables, balanced search trees (e.g., AVL trees, Red-Black trees) Discuss the differences between directed and undirected graphs.		Implement elementary symbol tables using a programming language. Perform basic operations (insertion, deletion, search) on the symbol table.	Guide students to implement elementary symbol tables using a programming language. Guide students to perform basic operations (insertion, deletion, search) on the symbol table.	

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	7.8 Explain algorithms for minimum spanning trees 7.9 Explain graph-related terminologies	Discuss algorithms for minimum spanning trees (e.g., Prim's, Kruskal's) and shortest paths (e.g., Dijkstra's, Bellman-Ford).			
	7.10 Explain how to apply graph algorithms to solve problems.	Explain how to apply graph algorithms to solve problems.			
	7.11 Define key terms such as worst-case, best-case, and average-case complexity	Discuss graph-related terminologies (e.g., nodes, edges, cycles) and apply graph algorithms to solve problems.			
	7.12 Explain Big O notation, breaking down its components and how it represents the upper bound of an algorithm's growth rate.	Describe Big O notation, breaking down its components and how it represents the upper bound of an algorithm's growth rate.			
	7.13 Define key terms related to sorting				

	algorithms (e.g., comparison-based sorting, non-comparison-based sorting) and searching algorithms

7.14 Explain factors to consider, such as time complexity, space complexity, and practical performance. | Define key terms related to sorting algorithms (e.g., comparison-based sorting, non-comparison-based sorting) and searching algorithms

Discuss factors to consider, such as time complexity, space complexity, and practical performance. | | | | |
| **General Objective 8.0:** Comprehend Substring Search, Regular Expression, and Data Compression | | | | | | |
| 15 | 8.1 Explain substring search algorithms their significance and applications.

8.2 Explain the basic concepts behind the Knuth-Morris-Pratt (KMP) and Boyer-Moore algorithms | Discuss on substring search algorithms their significance and applications.

Explain the basic concepts behind the Knuth-Morris-Pratt (KMP) and Boyer-Moore algorithms, including their motivations and advantages. | Marker board, Markers, Documentary films, Multimedia Projector and Screen, Case studies, Power point slides, Internet, Textbooks, Computer, Flip charts etc. | Use code snippets and interactive coding environments to demonstrate how the KMP and Boyer-Moore algorithms work. | Use code snippets and interactive coding environments to demonstrate how the KMP and Boyer-Moore algorithms work. | Discuss on substring search algorithms their significance and applications.

Explain the basic concepts behind the Knuth-Morris-Pratt (KMP) |

8.3 Explain step-by-step walkthroughs of the KMP and Boyer-Moore algorithms using examples and diagrams.	Discuss step-by-step walkthroughs of the KMP and Boyer-Moore algorithms using examples and diagrams.		Demonstrate algorithmic behaviour when searching for substrings in different text inputs.	Guide students to demonstrate algorithmic behaviour when searching for substrings in different text inputs.	and Boyer-Moore algorithms, including their motivations and advantages.
8.4 Explain the differences between KMP and Boyer-Moore algorithms in terms of efficiency, preprocessing, and text searching strategies.	Explain the differences between KMP and Boyer-Moore algorithms in terms of efficiency, preprocessing, and text searching strategies.		Implement the KMP and Boyer-Moore algorithms in a programming language of their choice.	Guide students to implement the KMP and Boyer-Moore algorithms in a programming language of their choice.	
8.5 Explain the time complexity and space complexity of the KMP and Boyer-Moore algorithms.	Discuss the time complexity and space complexity of the KMP and Boyer-Moore algorithms.		Use substring search algorithms in text processing, DNA sequencing, or	Guide students to Use substring search algorithms in text processing, DNA	
8.6 Explain the trade-offs between the two algorithms in terms of preprocessing time, memory usage, and search efficiency.	Discuss the trade-offs between the two algorithms in terms of preprocessing time, memory usage, and search efficiency.				

				plagiarism detection.	sequencing, or plagiarism detection.	
	8.7 Define key terms, symbols, and concepts related to regular expressions, such as metacharacters, patterns, and matching.	Define key terms, symbols, and concepts related to regular expressions, such as metacharacters, patterns, and matching.		Solve above problems using the KMP and Boyer-Moore algorithms.	Guide students to solve above problems using the KMP and Boyer-Moore algorithms	
	8.8 Explain regular expression components using real-world examples.	Discuss regular expression components using real-world examples.				
	8.9 Explain data compression techniques (e.g., Huffman coding) and their implementation	Discuss data compression techniques, focusing on Huffman coding as a specific example.		Develop text processing projects that involve real-world scenarios.	Guide students to develop text processing projects that involve real-world scenarios, such as data extraction from a website or analyzing log files.	
				Solve specific text processing tasks, such as	Guide students to solve specific	

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				extracting email addresses or validating phone numbers, using regular expressions.	text processing tasks, such as extracting email addresses or validating phone numbers, using regular expressions.	

Mathematics and Statistics for AI

PROGRAMME: HIGHER NATIONAL DIPLOMA ARTIFICIAL INTELLIGENCE		
COURSE TITLE: Mathematics and Statistics for AI	**Course Code: AIT 315**	**Contact Hours:** 4 Hours/ Week
CREDIT UNITS: 3	**PRE-REQUISITE:**	**Theoretical:** 2 Hours/Week
YEAR: ONE	**SEMESTER: ONE**	**Practical:** 2 Hours/Week
GOAL: This course is designed to provide students with a solid foundation in mathematics and statistics to enable them apply mathematical and statistical methods to AI algorithms, models, and applications		
General Objectives: On completion of the course, the student should be able to: 1.0 Understand Mathematical Foundations 2.0 Comprehend Statistical Data Analysis. 3.0 Understand Optimization Techniques 4.0 Understand Probability and Bayesian Methods 5.0 Comprehend Linear Algebra for AI 6.0 Understand multivariate Calculus 7.0 Apply Real-world Mathematical solutions in AI		

PROGRAMME: HIGHER NATIONAL DIPLOMA ARTIFICIAL INTELLIGENCE						
COURSE: Mathematics and Statistics for AI		**COURSE CODE: AIT 315**		**Contact Hours:** 4 Hours/ Week		
CREDIT UNITS: 3		**PRE- REQUISITE: Nil**		**Theoretical:** 2 Hours/Week		
				Practical: 2 Hours/Week		
GOAL: This course is designed to provide students with a solid foundation in mathematics and statistics to enable them apply mathematical and statistical methods to AI algorithms, models, and applications						
COURSE SPECIFICATION: Theoretical Contents:			**Practical Contents:**			
	General Objective 1.0: Understand Mathematical Foundations					
WEEK	**Specific Learning Outcomes**	**Teachers Activities**	**Learning Resources**	**Specific Learning Outcomes**	**Teachers Activities**	**Evaluation**
1-2	1.1 Explain Calculus and Its application in AI 1.2 Explain Linear Algebra for AI 1.3 Explain Data Representation for AI 1.4 Explain Probability Theory in AI Modeling	Discuss the fundamental concept of AI - Principles & Concept of AI - AI History & Definitions - Subfields of AI	White Board. multimedia Projector MATLAB, WEKA, SPSS, TANAGRA,	Apply Probability Theory in AI Modeling Use linear algebra techniques for data representation in AI. Use probability theory to evaluate	Guide students to apply Probability Theory in AI Modeling Guide students to use linear algebra techniques for data representation in AI. Guide students to use probability	Explain Probability Theory in AI Modeling

				uncertainty model in AI	theory to evaluate uncertainty model in AI	
General Objective 2.0: Comprehend Statistical Data Analysis						
3-4	2.1 Explain Hypothesis Testing in AI 2.2 Explain Applications of hypothesis testing in AI 2.3 Explain Regression Analysis for AI Predictions 2.4 Explain methods of Application of Data Visualization in AI Insights 2.5 Describe Probability Distributions in AI Modeling 2.6 Explain Statistical Analysis in AI Decision-making	Discuss the concept of Hypothesis Testing in AI and its applications	White Board. multimedia Projector MATLAB, WEKA, SPSS, Data visualization tools and software for AI	Use regression analysis techniques in AI prediction tasks. Implement basic AI algorithms,	Guide students to use regression analysis techniques in AI prediction tasks. Guide students to implement basic AI algorithms, such as search algorithms (e.g., BFS, DFS), sorting algorithms, or simple machine learning algorithms (e.g., k-nearest neighbors)	Explain Applications of hypothesis testing in AI

		General Objective 3.0: Understand Optimization Techniques				
5-6	3.1 Explain Gradient Descent in AI Optimization	Discuss Gradient Descent in AI Optimization	White Board. multimedia Projector MATLAB, WEKA, SPSS, Data visualization tools and software for AI			Explain Convex Optimization for AI Models
	3.2 Explain Applications of Gradient Descent in AI optimization	Discuss Applications of Gradient Descent in AI optimization				
	3.3 Explain Convex Optimization for AI Models	Discuss Convex Optimization for AI Models				
	3.4 Explain application of stochastic gradient descent in AI Training	Describe Application of Stochastic Gradient Descent in AI Training				
	3.5 Explain the concept of Optimization Algorithms in AI Tasks	Discuss the Optimization Algorithms in AI Tasks				
		General Objectives: 4.0 Understand Probability and Bayesian Methods				
7-8	4.1 Explain Probability Theory for AI Reasoning	Discuss Probability Theory for AI Reasoning	White Board. multimedia Projector MATLAB, WEKA, SPSS, Data visualization tools and software for AI	Apply uncertainty modeling using probability and Bayesian methods.	Guide students to apply uncertainty modeling using probability and Bayesian methods.	Explain Probabilistic Models in AI Applications
	4.2 Explain the application of Bayesian Methods in AI Decision-making	Discuss the application of Bayesian Methods in AI Decision-making				
		Discuss Probabilistic Models in AI Applications				

	4.3 Explain Probabilistic Models in AI Applications 4.4 Explain Bayesian Inference for AI Parameter Estimation 4.5 Explain the application of Uncertainty Modeling in AI	Discuss Bayesian Inference for AI Parameter Estimation Explain Application of Uncertainty Modeling in AI				
	General Objective: 5.0: Comprehend Linear Algebra for AI					
9-10	5.1 Explain Matrix Operations for AI Data Manipulation 5.2 Explain the application of Eigenvectors in AI Dimensionality Reduction 5.3 Explain Linear Transformations in AI Modeling 5.4 Explain linear Algebra Application in AI Optimization	Discuss Matrix Operations for AI Data Manipulation Describe Application of Eigenvectors in AI Dimensionality Reduction Discuss matrix representations for AI algorithms and model design.	White Board. multimedia Projector MATLAB, WEKA, SPSS, Data visualization tools and software for AI	Demonstrate eigenvectors' role in AI dimensionality reduction. Optimize AI algorithms using techniques of linear algebra	Guide students to demonstrate eigenvectors' role in AI dimensionality reduction. Guide students to apply linear algebra techniques to optimize AI algorithms.	Describe Application of Eigenvectors in AI Dimensionality Reduction

	General Objective 6.0: Understand multivariate Calculus					
11-13	6.1 Explain the concept of Multivariate Calculus 6.2 Describe Application of Partial Derivatives in AI Function Optimization 6.3 Explain gradient vectors in neural Network 6.4 Explain the significance of Hessian Matrices in AI Optimization 6.5 Explain the Applications of Hessian Matrices in AI Optimization 6.6 Explain multivariate calculus in Complex AI Model Optimization	Explain the concept of Multivariate Calculus Describe Application of Partial Derivatives in AI Function Optimization Discuss gradient vectors in neural Network Discuss the significance of Hessian Matrices in AI Optimization Discuss the Applications of Hessian Matrices in AI Optimization Discuss multivariate calculus in Complex AI Model Optimization	White Board. multimedia Projector MATLAB, WEKA, SPSS, Data visualization tools and software for AI	Use partial derivatives in AI function optimization Apply multivariate calculus techniques to optimize complex AI models	Guide students to use partial derivatives in AI function optimization. Guide students to apply multivariate calculus techniques to optimize complex AI models.	Explain the concept of Multivariate Calculus
	General Objective 7.0: Apply Real-world Mathematical solutions in AI					
14-15	7.1 Explain Statistical Modeling in AI Predictive Analytics	Discuss Statistical Modeling in AI Predictive Analytics	Statistical modeling tools and libraries for AI	Apply Linear Algebra in AI Data Analysis	Guide students to Apply Linear Algebra in	Explain Statistical Modeling in AI Predictive Analytics

	7.2 Explain Optimization Techniques in AI Model	Discuss Optimization Techniques in AI Model			AI Data Analysis
	7.3 Explain Bayesian Inference in AI Decision-making	Discuss Bayesian Inference in AI Decision-making		Analyse AI datasets using linear algebra techniques.	Guide students to analyse AI datasets using linear algebra techniques.
	7.4 Explain Probability-based AI Risk Assessment	Discuss Probability-based AI Risk Assessment		Build statistical models for AI predictive analytics.	Guide students in building statistical models for AI predictive analytics.
				Optimize AI models using various optimization techniques	Guide students to optimize AI models using various optimization techniques
				Carry out AI Risk Assessment using probability	Guide students to carry out AI Risk

					Assessment using probability	

Ethical and Professional Practice in Artificial Intelligence (AI)

PROGRAMME: HIGHER NATIONAL DIPLOMA ARTIFICIAL INTELLIGENCE		
COURSE TITLE: Ethical and Professional Practice in Artificial Intelligence (AI)	**Course Code: AIT 317**	**Contact Hours:** 2 Hours/ Week
CREDIT UNITS: 2	**PRE-REQUISITE:**	**Theoretical:** 2 Hours/Week
SEMESTER: ONE	**YEAR: ONE**	**Practical:** 0 Hours/Week
GOAL: This course is designed to enable students to acquire knowledge and skills to navigate the ethical challenges that arise in the rapidly evolving field of artificial intelligence		
General Objectives: On completion of the course, the student should be able to: 1.0 Understand ethical awareness related to the design, development, and deployment of AI technologies. 2.0 Know ethical decision-making when working with AI technologies. 3.0 Comprehend AI systems that adhere to ethical principles. 4.0 Comprehend the importance of safeguarding user privacy and personal data in AI applications. 5.0 Comprehend potential biases in AI algorithms and strategies to mitigate bias. 6.0 Explore the societal and legal implications of AI technologies. 7.0 Comprehend professional ethics and responsible conduct in AI development and research		

PROGRAMME: HIGHER NATIONAL DIPLOMA ARTIFICIAL INTELLIGENCE			
COURSE: Ethical and Professional Practice in Artificial Intelligence (AI)	**COURSE CODE: AIT 317**		**Contact Hours:** 2 Hours/ Week
CREDIT UNITS: 2	**PRE- REQUISITE: Nil**		**Theoretical:** 2 Hours/Week **Practical:** 0 Hours/Week
GOAL: This course is designed to enable students to acquire knowledge and skills to navigate the ethical challenges that arise in the rapidly evolving field of artificial intelligence			
COURSE SPECIFICATION: Theoretical Contents:		**Practical Contents:**	
General Objective 1.0: Understand ethical Awareness related to the design, development, and deployment of AI technologies			

WEEK	Specific Learning Outcomes	Teachers Activities	Learning Resources	Specific Learning Outcomes	Teachers Activities	Evaluation
1-2	1.1 Explain Ethical Principles in AI 1.2 Explain Ethical Dilemmas in AI Applications 1.3. Explain the Impact of AI on Society and Individuals 1.4. Explain how to examine Privacy and Data Protection in AI 1.5 Explain how to evaluate Bias and Fairness in AI	Discuss principles and values relevant to AI development. Discuss ethical dilemmas in AI applications. Discuss AI's societal impact. Discuss privacy and data protection regulations in AI. Discuss Bias and Fairness in AI				Explain Ethical Dilemmas in AI Applications

General Objective 2.0: Know ethical decision-making when working with AI technologies.						
3-4	2.1. Explain Ethical Decision-making in AI	Discuss ethical decision-making principles and methodologies.				Explain ethical decision-making principles and methodologies.
	2.2. Analyze Ethical Dilemmas in AI Applications	Discuss ethical dilemmas in AI applications.				
	2.3. Explain ethical Considerations in AI Research	Discuss ethical considerations in AI research projects.				
	2.4. Explain Impact on Stakeholders in AI Decisions	Discuss the impact of AI decisions on stakeholders.				
	2.5. Explain Ethical Frameworks in AI Decision-making	Discuss ethical frameworks applicable to AI decisions.				
General Objective 3.0: Comprehend AI systems that adhere to ethical principles.						
5-6	3.1. Explain Ethical Principles in AI Development	Discuss Ethical Principles in AI Development				Discuss how to promote Fairness and Transparency in AI Algorithms
	3.2. Explain how to promote Fairness and Transparency in AI Algorithms	Discuss how to promote Fairness and Transparency in AI Algorithms				
	3.3. Explain accountability in AI Decision-making	Discuss Accountability in AI Decision-making				

	3.4. Explain ethical Data Collection and Usage in AI	Explain ethical Data Collection and Usage in				
General Objectives: 4.0 Comprehend the importance of safeguarding user privacy and personal data in AI applications.						
7-8	4.1. Explain Privacy and Data Protection Principles	Discuss Privacy and Data Protection Principles				Explain ethical use of User Data in AI Applications
	4.2. Explain Privacy Regulations in AI	Discuss Privacy Regulations in AI				
	4.3. Explain Data Minimization and Consent in AI	Discuss Data Minimization and Consent in AI				
	4.4. Explain how to Secure Data Storage and Transmission in AI	Discuss how to Secure Data Storage and Transmission in AI				
	4.5. Explain ethical use of User Data in AI Applications	Discuss the ethical Use of User Data in AI Applications				
General Objective: 5.0 Comprehend potential biases in AI algorithms and strategies to mitigate bias.						
9-10	5.1. Explain AI Bias and Its Impact	Discuss AI Bias and Its Impact				Explain Biases in AI Algorithms
	5.2. Explain Biases in AI Algorithms	Discuss Biases in AI Algorithms				
	5.3. Explain how to evaluate Fairness					

	Metrics for AI Decision-making 5.4. Explain Strategies to Mitigate Bias in AI Applications 5.5. Explain ethical Considerations in AI Bias and Fairness	Discuss how to evaluate Fairness Metrics for AI Decision-making Explain Strategies to Mitigate Bias in AI Applications Discuss ethical Considerations in AI Bias and Fairness				
General Objective 6.0: Explore the societal and legal implications of AI technologies						
11-12	6.1. Explain the Social Impact of AI 6.2 Explain Legal Implications of AI 6.3 Explain AI's Impact on Privacy Laws 6.4. Explain ethical Considerations in AI Applications 6.5. Explain AI's Impact on Human Rights	Discuss the Social Impact of AI Discuss Legal Implications of AI Discuss AI's Impact on Privacy Laws Discuss ethical Considerations in AI Applications Discuss how to address AI's Impact on Human Rights				Explain ethical Considerations in AI Applications
General Objective 7.0 Comprehend professional ethics and responsible conduct in AI development and research						
13-15	7.1. Explain Professional Ethics in AI	Discuss Professional Ethics in AI				Explain transparency and accountability

	7.2. Explain how to promote Responsible AI Development	Discuss how to promote responsible AI development				in AI Development
	7.3. Adhere to Ethical Guidelines in AI Research	Discuss Ethical Guidelines in AI Research				
	7.4. Explain transparency and accountability in AI Development	Discuss transparency and accountability in AI Development				
	7.5. Explain ethical Decision-making in AI Applications	Discuss ethical Decision-making in AI Applications				

YEAR ONE SEMESTER TWO COURSES

Machine Learning

Programme: Higher National Diploma Artificial Intelligence	Course Code: AIT 321	Contact Hours: 4 Hours/Week
Course Title: Machine Learning	Credit Units: 3	Theoretical: 2 hour /week
Year: 1 Semester: 2	Pre-requisite: AIT 313	Practical: 2 hour /week
Goal: The goal of this course is to cultivate an in-depth understanding of machine learning principles and applications, enabling students to solve real-world problems.		
General Objectives: On completion of this course the student should be able to: 1.0 Understand machine learning basics. 2.0 Understand the processes of machine learning. 3.0 Recognize model parameters and hyperparameters in machine learning experiments. 4.0 Utilize common machine learning algorithms, applying feature selection and dimensionality reduction techniques for optimization. 5.0 Apply machine learning to real-world cases across various industries 6.0 Understand the ethical implications of machine learning in ensuring responsible AI development. 7.0 Recognize how to foster a culture of continuous learning and adaptation of latest machine learning advancements.		

PROGRAMME: HIGHER NATIONAL DIPLOMA ARTIFICIAL INTELLIGENCE			
Course: Machine Learning	**COURSE CODE: AIT 321**		**Contact Hours:** 4 Hours/Week
Credit Units: 3	**Pre-requisite: AIT 313**		**Theoretical:** 2 hour /week
			Practical: 2 hour /week
Goal: The goal of this course is to cultivate an in-depth understanding of machine learning principles and applications, enabling students to solve real-world problems.			
COURSE SPECIFICATION: Theoretical Contents:		**Practical Contents:**	

	General Objective: 1.0 Understand machine learning basics					
WEEK	**Specific Learning Outcomes**	**Teachers Activities**	**Learning Resources**	**Specific Learning Outcomes**	**Teachers Activities**	**Evaluation**
1-2	1.1 Explain the basics of machine learning

1.2 Explain the differences and applications of supervised, unsupervised, and reinforcement learning

1.3 Explain the performance of supervised, unsupervised, and reinforcement | Discuss machine learning basics

Discuss the applications and differences between supervised, unsupervised, and reinforcement learning.

Discuss the performance of different machine learning types, guiding students in analyzing | Textbooks, Online articles, Video lectures, Python with Scikit-Learn, TensorFlow, Real-world datasets. Lectures, Online tutorials, Python with Scikit-Learn, TensorFlow, Real-world datasets. Python tutorials, Code samples, Python with Scikit-Learn, TensorFlow, Real-world datasets. Python tutorials, Code samples, | Implement basic models using Python and Scikit-Learn.

Create a project utilizing supervised, unsupervised, and reinforcement learning models

Develop basic models of supervised, | Guide students to implement basic models.

Guide students to create a project utilizing supervised, unsupervised, and reinforcement learning models

Guide students to develop basic models of supervised, unsupervised, and | Explain the differences and applications of supervised, unsupervised, and reinforcement learning |

| | learning models | the strengths and weaknesses of each. | Python with Scikit-Learn, TensorFlow, Real-world datasets. Project-based learning guides, Python tutorials, Code samples, Python with Scikit-Learn, TensorFlow, Real-world datasets. | unsupervised, and reinforcement learning

Analyze the performance of implemented models and | reinforcement learning

Guide students to analyze the performance of implemented models and | |
|---|---|---|---|---|---|---|
| | 1.4 Explain the differences and applications of the three types of machine learning | | | | | |
| | **General Objectives:2.0** Understand the processes of machine learning | | | | | |
| 3-5 | 2.1 Explain the process of machine learning

2.2 Explain the significance of each step in the machine learning process

2.3 Explain how to apply the machine learning process to a | Discuss the complete process of machine learning from problem identification to model evaluation.

Discuss the importance of each step such as data collection, preprocessing, algorithm selection, model training and evaluation

Discuss how to apply the machine learning | Textbooks, Online articles, Video lectures, Python with Scikit-Learn, TensorFlow, Real-world datasets. Lectures, Online tutorials, Python with Scikit-Learn, TensorFlow, Real-world datasets. Python tutorials, Code samples, Python with Scikit-Learn, TensorFlow, Real-world datasets. Python tutorials, Code samples, Python with Scikit- | Implement the complete process of machine learning to solve a given problem

Develop a machine learning project from scratch, following the complete process and using different algorithms (Creating). | Guide students to implement the process of machine learning to a given problem

Guide students to develop machine learning projects. | Explain the complete process of machine learning from problem identification to model evaluation. |

	specific problem using Python	process to a specific problem using Python.	Learn, TensorFlow, Real-world datasets. Project-based learning guides, Python tutorials, Code samples, Python with Scikit-Learn, TensorFlow, Real-world datasets.			
General Objective 3.0: Recognize model parameters and hyperparameters in machine learning experiments.						
6-8	3.1 Explain the concepts of model parameters and hyperparameters in machine learning

3.2 Explain the roles of model parameters and hyperparameters in machine learning experiments

3.3 Explain different values of hyperparameters in a given machine learning model.

3.4 Explain Optimization of | Discuss model parameters and hyperparameters, and their differences

Discuss the roles that parameters and hyperparameters play in the training of machine learning models

Discuss how to adjust hyperparameters in a machine learning model using Python.

Explain the process of hyperparameter tuning | Textbooks, Online articles, Video lectures, Python with Scikit-Learn, TensorFlow, Real-world datasets. Lectures, Online tutorials, Python with Scikit-Learn, TensorFlow, Real-world datasets. Python tutorials, Code samples, Python with Scikit-Learn, TensorFlow, Real-world datasets. Python tutorials, Code samples, Python with Scikit- | Implement different values of hyperparameters in provided machine learning models

Develop optimized machine learning models by tuning hyperparameters

Analyse machine learning models' performance with different hyperparameters | Guide students to adjust hyperparameters in given machine learning models.

Guide students to develop their own optimized machine learning models through hyperparameter tuning.

Guide students to analyse machine learning models' performance with | Explain how to analyze the performance of machine learning models with different hyperparameters |

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	machine learning models by tuning hyperparameters	for optimizing machine learning models.	Learn, TensorFlow, Real-world datasets. Project-based learning guides, Python tutorials, Code samples, Python with Scikit-Learn, TensorFlow, Real-world datasets.		different hyperparameters	
	3.5 Explain the impact of different hyperparameters on the performance of given machine learning models	Discuss the impact of different hyperparameters on the performance of given machine learning models Discuss on the performance analysis of machine learning models with different hyperparameters.				
General Objective 4.0: Utilize common machine learning algorithms, applying feature selection and dimensionality reduction techniques for optimization.
9-11	4.1 Explain common machine learning algorithms and dimensionality reduction techniques 4.2 Explain the concept and benefits of feature selection and dimensionality reduction	Discuss various machine learning algorithms and dimensionality reduction techniques. Discuss the concepts of feature selection and dimensionality reduction and their benefits with examples	Textbooks, Online articles, Video lectures, Python with Scikit-Learn, TensorFlow, Real-world datasets. Lectures, Online tutorials, Python with Scikit-Learn, TensorFlow, Real-world datasets.	Implement feature selection and dimensionality reduction techniques on provided datasets Evaluate the impact of feature selection and dimensionality	Guide students to apply learned techniques on datasets. Guide students to evaluate the impact of feature selection and	Explain the concept and benefits of feature selection and dimensionality reduction

	4.3 Explain the process of creating optimized machine learning models using feature selection and dimensionality reduction techniques.	Explain how to apply feature selection and dimensionality reduction techniques on datasets using Python.	Python tutorials, Code samples, Python with Scikit-Learn, TensorFlow, Real-world datasets.	reduction on given machine learning models	dimensionality reduction on given machine learning models	
	4.4 Explain the performance of machine learning models after applying feature selection and dimensionality reduction	Discuss the performance analysis of machine learning models.	Python tutorials, Code samples, Python with Scikit-Learn, TensorFlow, Real-world datasets. Project-based learning guides, Python tutorials, Code samples, Python with Scikit-Learn, TensorFlow, Real-world datasets.	Develop optimized machine learning models using feature selection and dimensionality reduction techniques	Guide students to develop their own optimized machine learning models.	
General Objective: 5.0 Apply machine learning to real-world cases across various industries.						
12-13	5.1 Explain how machine learning can be applied in various industries	Discuss the application of machine learning across different sectors such as healthcare, finance, transportation, and more.	Textbooks, Online articles, Video lectures, Software like Python with libraries (Scikit-Learn, TensorFlow, etc.), Real-world datasets.	Create machine learning solutions for real-world problems in various industries	Guide students on how to match suitable machine learning solutions to real-world problems.	Evaluate the effectiveness of machine learning solutions in given case studies
	5.2 Explain how to identify suitable machine learning	Discuss different real-world scenarios where machine learning can	Case studies, Online tutorials, Research papers, Software like Python with libraries	Analyze the results of applied machine learning	Guide students to develop their own machine learning solutions for real-world problems.	

solutions for given real-world problems	be used to solve problems.	(Scikit-Learn, TensorFlow, etc.), Real-world datasets.	in real-world cases	
5.3 Explain the results of applied machine learning in real-world cases	Explain real-world machine learning applications	Academic journals, TED Talks, Expert interviews, Software like Python with libraries (Scikit-Learn, TensorFlow, etc.), Real-world datasets.		
5.3 Explain the effectiveness of machine learning solutions in given case studies	Discuss methods for evaluating the effectiveness of machine learning solutions in real-world applications.	Coding tutorials, Algorithm design books, Online course materials, Software like Python with libraries (Scikit-Learn, TensorFlow, etc.), Real-world datasets. Project-based learning guides, Comprehensive tutorials, Industry case studies, Software like Python with libraries (Scikit-Learn, TensorFlow, etc.), Real-world datasets.		

General Objective 6.0: Understand the ethical implications of machine learning in ensuring responsible AI development.						
14	6.1 Explain key ethical considerations in machine learning	Discuss ethical considerations in machine learning including bias, privacy, accountability, and transparency.	Textbooks, Online articles, Video lectures. Case studies, Online tutorials, Lectures. Python tutorials, Code samples, Python with Scikit-Learn, TensorFlow, Real-world datasets.	Apply ethical principles into the design of a machine learning project	Guide students to apply ethical principles to their machine learning projects.	Explain how to incorporate ethical considerations into the design of a machine learning project.
	6.2 Explain the ethical implications of machine learning and AI					
		Discuss how to incorporate ethical considerations into the design of a machine learning project.	Case studies, Lectures, Online resources. Python tutorials, Code samples, Python with Scikit-Learn, TensorFlow, Real-world datasets.	Assess the impact of ethical and unethical practices in real-world machine learning cases	Guide students to assess the impact of ethical and unethical practices.	
	6.3 Explain ethical principles to machine learning project design					
		Discuss ways to address potential biases, ensure privacy, and enhance transparency.		Develop strategies to mitigate ethical issues in their machine learning projects	Guide students to formulate strategies to address ethical issues in their projects.	
	6.4 Explain the impact of ethical and unethical practices in machine learning	Discuss about the impact of ethical and unethical practices in machine learning using real-world examples.				
	6.5 Explain the strategies to	Explain strategies to mitigate ethical issues				

	mitigate ethical issues in machine learning projects	in machine learning projects				
General Objective 7.0 Recognize how to foster a culture of continuous learning and adaptation of latest machine learning advancements.						
15	7.1 Explain recent advancements in the field of machine learning 7.2 Explain impacts and applications of these advancements 7.3 Explain the differences between new advancements and existing methods	Discuss latest advancements and trends in machine learning. Discuss the potential impacts and applications of the latest advancements in machine learning. Discuss the differences between new advancements and existing methods	Textbooks, Online articles, Video lectures, Research papers. Case studies, Online tutorials, Lectures, Research papers. Python tutorials, Code samples, Python with Scikit-Learn, TensorFlow, Real-world datasets, Latest ML libraries. Textbooks, Online articles, Video lectures, Research papers. Project-based learning guides, Python tutorials, Code samples, Python with Scikit-Learn, TensorFlow, Real-world datasets, Latest ML libraries.	Develop a project that incorporates the latest advancements in machine learning	Guide students to use the latest tools and techniques in machine learning projects.	Explain the differences between new advancements and existing methods

Computer Vision

PROGRAMME: HIGHER NATIONAL DIPLOMA ARTIFICIAL INTELLIGENCE		
COURSE TITLE: Computer Vision	**Course Code: AIT 322**	**Contact Hours:** 4 Hours/Week
CREDIT UNITS: 3	**PRE-REQUISITE: Nil**	**Theoretical:** 2 hour /week
YEAR: ONE	**SEMESTER: TWO**	**Practical:** 2 hour /week
GOAL: This course is designed to provide students with a comprehensive understanding of the concepts, methodologies, and prevalent practices in computer vision.		
General Objectives: On completion of the course, the student should be able to: 1.0 Comprehend fundamental concepts, principles, and theories underlying computer vision. 2.0 Implement key computer vision techniques and algorithms for image analysis and understanding. 3.0 Apply computer vision techniques for feature detection, object recognition, image segmentation, and scene reconstruction. 4.0 Comprehend major computer vision libraries and tools such as OpenCV effectively. 5.0 Integrate machine learning algorithms, including deep learning, to improve vision tasks. 6.0 Evaluate the performance and efficiency of various computer vision algorithms. 7.0 Design a computer vision system for a real-world application, demonstrating the practical application of learned theories and techniques.		

PROGRAMME: HIGHER NATIONAL DIPLOMA ARTIFICIAL INTELLIGENCE						
Course: Computer Vision		**COURSE CODE: AIT 322**			**Contact Hours:** 4 Hours/Week	
CREDIT UNITS: 3		**PRE- REQUISITE: Nil**			**Theoretical:** 2 Hours/Week	
					Practical: 2 Hours/Week	
GOAL: This course is designed to provide students with a comprehensive understanding of the concepts, methodologies, and prevalent practices in computer vision.						
COURSE SPECIFICATION: Theoretical Contents:				**Practical Contents:**		
General Objective: 1.0 Comprehend fundamental concepts, principles, and theories underlying computer vision.						
WEEK	**Specific Learning Outcomes**	**Teachers Activities**	**Learning Resources**	**Specific Learning Outcomes**	**Teachers Activities**	**Evaluation**
1-2	1.1 Explain computer vision and its application in various industries. 1.2 Explain the structure and function of the human visual system as a foundation for understanding computer vision. 1.3 Explain the fundamentals of digital image formation and representation. 1.4 Explain the concept of image processing	Discuss computer vision and its application with real-life examples. Discuss the human visual system, its workings, and comparison with computer vision systems. Discuss digital image formation and representation using various visual aids. Discuss image processing and	White Board PC Projector or digital whiteboard for delivering lectures, Computer lab with workstations installed with appropriate image processing software, Sample digital images for demonstrations and practice, Software tools for	Demonstrate digital image formation and representation. Use image processing and enhancement techniques. Identify various image features and their extraction methods.	Guide students to experiment with digital image formation and representation Guide students to apply image processing and enhancement techniques to different feature extraction methods on various types of images.	Explain the fundamentals of digital image formation and representation.

	and enhancement techniques. 1.5 Explain various image features and their extraction methods.	enhancement techniques with examples. Discuss image features and their extraction methods and showcase their application in computer vision.	demonstrating image processing techniques, such as MATLAB or OpenCV.			
General Objectives:2.0 Implement key computer vision techniques and algorithms for image analysis and understanding**.**						
3-4	2.1 Explain image segmentation techniques. 2.2 Explain Application of object recognition algorithms in different scenarios. 2.3 Explain machine learning methods in computer vision for pattern classification and recognition. 2.4 Explain convolutional neural networks for image processing and analysis.	Discuss the principles of image segmentation using relevant software tools. Discuss various object recognition algorithms Explain the applications of machine learning in computer vision, provide relevant examples. Discuss convolutional neural networks, their architecture and usage in image analysis.	Computer lab with workstations equipped with software tools for image analysis (like MATLAB, OpenCV). Projector or digital whiteboard for teaching and demonstrating concepts. Datasets of images for hands-on practice in class.	Implement image segmentation techniques. Apply object recognition algorithms to real-world scenarios. Use convolutional neural networks for image processing and analysis.	Guide students to implement image segmentation techniques. Guide students to apply object recognition algorithms to real-world scenarios. Guide students to use convolutional neural networks for image processing and analysis.	Describe machine learning methods in computer vision for pattern classification and recognition.

	2.5 Explain stereo vision and 3D reconstruction techniques in computer vision applications.	Discuss the concepts of stereo vision and 3D reconstruction, use visual aids for better understanding.				
	General Objective 3.0: Apply computer vision techniques for feature detection, object recognition, image segmentation, and scene reconstruction					
5-7	3.1 Explain various feature detection techniques in computer vision. 3.2 Explain various feature detection techniques in computer vision. 3.3 Explain how to implement object recognition algorithms and their application in various real-world scenarios. 3.4 Explain image segmentation techniques. 3.5 Explain scene reconstruction using computer vision techniques.	Discuss the different feature detection techniques, and their application in computer vision. Discuss object recognition algorithms. Discuss the principles image segmentation techniques and their applications in computer vision.	Computers equipped with software tools for computer vision, such as OpenCV or MATLAB. Datasets of images and videos for experimentation and practice. Projector or smartboard for teaching and demonstration purposes	Apply various feature detection techniques in computer vision. Apply image segmentation techniques. Execute scene reconstruction using computer vision techniques.	Guide students to apply feature detection techniques to real-world examples. Guide students to apply image segmentation techniques. Assist students as they execute image segmentation techniques on various images.	Explain various feature detection techniques in computer vision.

		Discuss the process of scene reconstruction using real-world examples and case studies.				
	General Objectives: 4.0 Comprehend major computer vision libraries and tools such as OpenCV effectively.					
8-9	4.1 Explain the basic functionalities and modules of OpenCV. 4.2 Explain OpenCV functions for image and video processing tasks. 4.3 Explain computer vision algorithms using OpenCV. 4.4 Explain how to solve common issues and errors in OpenCV programming	Discuss guided exploration of OpenCV's functionalities and modules. Discuss the application of OpenCV functions for image and video processing. Discuss the implementation of computer vision algorithms using OpenCV. Discuss common issues in OpenCV programming and show how to troubleshoot them.	White Board PC, Multimedia Projector User Interface prototyping software (like Pencil, Axure RP, Wireframe, Rapid UI, Design Sketch, etc.)	Use the basic functionalities and modules of OpenCV Apply OpenCV functions for image and video processing tasks Implement computer vision algorithms using OpenCV.	Guide students to use the basic functionalities and modules of OpenCV Guide students apply OpenCV functions for image and video processing tasks Guide students to implement computer vision algorithms using OpenCV in hands-on activities.	Explain OpenCV functions for image and video processing tasks

				Resolve common issues and errors in OpenCV programming.	Guide students to troubleshoot common issues they encounter during OpenCV programming Guide students to work on projects involving image and video processing using OpenCV.	
General Objective: 5.0 Integrate machine learning algorithms, including deep learning, to improve vision tasks						
10-11	5.1 Explain the applications of machine learning and deep learning algorithms in computer vision. 5.2 Explain machine learning algorithms to improve image classification, object detection, and other vision tasks.	Discuss the role of machine learning and deep learning in computer vision. Discuss the implementation of machine learning algorithms in computer vision tasks.	White Board PC Multimedia Projector User Interface prototyping software (like Pencil, Axure RP, Wireframe, Rapid UI, Design Sketch, etc.)	Apply deep learning techniques to enhance complex vision tasks. Demonstrate the implementation of machine learning algorithms in computer	Guide students to apply deep learning techniques to complex vision tasks Guide students to implement machine learning algorithms in computer vision tasks.	Explain the applications of machine learning and deep learning algorithms in computer vision.

	5.3 Explain deep learning techniques to enhance complex vision tasks. 5.4 Explain the performance of machine learning and deep learning models in computer vision tasks.	Discuss applications of deep learning techniques to complex vision tasks. Discuss the performance of different machine learning and deep learning models in computer vision tasks.		Implement machine learning algorithms to improve image classification, object detection, and other vision tasks. Evaluate the performance of machine learning and deep learning models in computer vision tasks.	Guide students to evaluate the performance of machine learning and deep learning models in computer vision tasks. Guide students to evaluate the performance of machine learning and deep learning models in computer vision tasks	
General Objective 6.0: Evaluate the performance and efficiency of various computer vision algorithms.						
12-13	6.1 Explain the metrics for evaluating the performance of computer vision algorithms. 6.2 Explain metrics above in practice to various computer vision algorithms.	Discuss the key performance metrics used in computer vision. Discuss how to apply these metrics to evaluate computer vision algorithms.	Computers with software for implementing and evaluating computer vision algorithms (such as Python with OpenCV, TensorFlow).	Apply the metrics for evaluating the performance of computer practice to compare various computer vision algorithms.	Guide students to apply performance metrics to computer vision algorithms.	Analyze and interpret the results of performance evaluation.

	6.3 Explain the results of performance evaluation. 6.4 Explain computer vision optimization concepts	Discuss various scenarios of performance evaluation results and their implications. Discuss optimization computer vision algorithms based on performance results	Variety of datasets to test the performance of algorithms. Projector or smartboard for teaching and demonstration.	Analyze and interpret the results of performance evaluation. Optimize computer vision algorithms based on the evaluation results	Assist students in analyzing and interpreting their evaluation results. Guide students through the process of optimizing a computer vision algorithm based on their evaluation results.	
General Objective 7.0 Design a computer vision system for a real-world application, demonstrating the practical application of learned theories and techniques**.**
14-15	7.1 Explain the process of designing a computer vision system. 7.2 Explain relevant machine learning algorithms for computer vision system. 7.3 Explain the concept of computer vision system testing	Discuss the steps and considerations in designing a computer vision system. Discuss how to implement a simple computer vision system. Explain the concept of computer vision system testing	Computers with software for implementing computer vision and machine learning algorithms (such as Python with OpenCV, TensorFlow). Variety of datasets to test	Apply knowledge of computer vision techniques to implement a functional system. Implement a simple computer vision system	Guide students to test and optimize the system for a chosen real-world application Guide students to implement their computer vision systems.	Explain the process of designing a computer vision system

| | 7.4 Explain system optimization for a chosen real-world application

7.5 Explain the process of incorporating machine learning algorithms into the system. | Explain system optimization for a chosen real-world application

Explain the process of incorporating machine learning algorithms into the system. | the performance of the designed system.
Projector or smartboard for teaching and demonstration. | Incorporate relevant machine learning algorithms into the system.

Test and optimise their computer vision systems | Guide students to incorporate machine learning algorithms into their systems.

Guide students to test and optimise computer vision systems their systems. | |

PROGRAMME: HIGHER NATIONAL DIPLOMA ARTIFICIAL INTELLIGENCE		
COURSE TITLE: Data Science for AI	**Course Code:** AIT 323	**Contact Hours:** 4 Hours/ Week
CREDIT UNITS: 3	**PRE-REQUISITE:**	**Theoretical:** 2 Hours/Week
YEAR: ONE	**SEMESTER: TWO**	**Practical:** 2 Hours/Week
GOAL: This course is designed to equip students with the knowledge and skills required to apply data science concepts and techniques in artificial intelligence.		
General Objectives: On completion of the course, the student should be able to: 1.0 Understand the fundamentals of data science and its intersection with artificial intelligence. 2.0 Comprehend the concepts of business intelligence and big data analytics in modern business decision-making. 3.0 Apply data science techniques to extract meaningful insights from large and complex datasets. 4.0 Use machine learning algorithms to build predictive models for various business scenarios. 5.0 Utilize data visualization tools to effectively communicate data-driven insights to both technical and non-technical audiences. 6.0 Understand the ethical and privacy issues related to the use of big data in artificial intelligence. 7.0 Design a data science project that addresses a real-world business problem.		

PROGRAMME: HIGHER NATIONAL DIPLOMA ARTIFICIAL INTELLIGENCE					
Course: Data Science for AI		**COURSE CODE: AIT 323**		**Contact Hours:** 4 Hours/Week	
CREDIT UNITS: 3		**PRE- REQUISITE: Nil**		**Theoretical:** 2 Hours/Week	
				Practical: 2 Hours/Week	
GOAL: This course is designed to equip students with the knowledge and skills required to apply data science concepts and techniques in artificial intelligence.					
COURSE SPECIFICATION: Theoretical Contents:			**Practical Contents:**		
General Objective: 1.0 **Understand the fundamentals of data science and its intersection with artificial intelligence**.					
WEEK	**Specific Learning Outcomes**	**Teachers Activities**	**Learning Resources**	**Specific Learning Outcomes**	**Teachers Activities**	**Evaluation**
1-2	1.1 Explain the key concepts and terminologies in data science and artificial intelligence. 1.2 Explain the role of data science in artificial intelligence and its application across various industries. 1.3 Explain the data science process, from data collection and preprocessing to modeling and evaluation.	Discuss key concepts and terminologies in data science and artificial intelligence. Discuss data science intersects with artificial intelligence across various industries. Discuss the data science process using real-world examples. Facilitate class discussions on each stage.	Slide presentations, textbooks, and online resources for lectures. Access to case studies and research papers on data science and AI. Computer with data analysis software (e.g., Python with libraries like pandas, NumPy, scikit-learn) for demonstrating the data science process. Python with TensorFlow, Keras)	Use data science process, from data collection and preprocessing to modeling and evaluation. Use the basics of machine learning, including supervised and	Assign students with a dataset and guide them through the data science process, from cleaning and preprocessing the data to modeling and interpreting the results. Provide students with exercises in implementing basic machine	Explain the key concepts and terminologies in data science and artificial intelligence.

				unsupervised learning algorithms.	learning algorithms using appropriate software.	
	1.4 Explain the basics of machine learning, including supervised and unsupervised learning algorithms.	Discuss the basics of machine learning, include both theoretical concepts and practical examples.		unsupervised learning algorithms.	learning algorithms using appropriate software.	
	General Objective 2.0 Comprehend the concepts of business intelligence and big data analytics in modern business decision-making					
3-4	1.1 Explain the key concepts, tools, and applications of business intelligence (BI) and big data analytics. 1.2 Explain the role of BI and big data analytics in driving business decisions. 1.3 Explain the processes involved in BI and big data analytics, including data mining, data warehousing, and data visualization. 1.4 Explain the ethical	Discuss the tools and applications of BI and big data analytics. Include discussions on BI software like Tableau and big data platforms like Hadoop. Discuss the impact of BI and big data analytics on business decision-making. Discuss the ethical considerations and challenges in BI and big data analytics	Slide presentations, textbooks, and online resources for lectures. Case studies on companies that effectively use BI and big data analytics. Access to BI software like Tableau and big data platforms like Hadoop. Articles and materials on ethical considerations in BI and big data analytics	Carry out the processes involved in BI and big data analytics, including data mining, data warehousing, and data visualization. Use the key concepts, tools, and applications of business intelligence (BI) and big data analytics.	Guide students to implement data mining, data warehousing, and data visualization techniques using BI software or big data platforms. Guide students to explore different BI tools and big data platforms.	Explain the processes involved in BI and big data analytics, including data mining, data warehousing, and data visualization.

considerations and challenges in BI and big data analytics, such as privacy and data security.						
General Objective 3.0: Apply data science techniques to extract meaningful insights from large and complex datasets.						
5-7	3.1 Explain how to clean and preprocess large and complex datasets to make them suitable for analysis. 3.2 Explain various data science techniques such as machine learning algorithms, statistical analysis, and data visualization to derive insights from data. 3.3 Explain data science tools and programming languages, such as Python, R, SQL, and data visualization tools effectively.	Discuss data cleaning and preprocessing using real-world datasets. Discuss different data science techniques through step-by-step guided sessions. Discuss data science tools and programming languages, such as Python, R, SQL, and data visualization tools effectively.	Access to datasets for cleaning and preprocessing. Data science software and platforms like Jupyter Notebook, Studio, or Tableau for demonstrating techniques. Resources for learning effective data communication (videos, books, online courses). Computers with necessary data science software and tools installed (Python, R, SQL, data visualization tools).	Apply big data techniques to clean and preprocess large datasets to make them suitable for analysis. Apply various data science techniques such as machine learning algorithms, statistical analysis, and data visualization to derive insights from data.	Guide students to apply big data techniques to clean and preprocess large datasets to make them suitable for analysis Guide students to apply various data science techniques such as machine learning algorithms, statistical analysis, and data	Describe various data science techniques such as machine learning algorithms, statistical analysis, and data visualization to derive insights from data.

				Utilize data science tools and programming languages, such as Python, R, SQL, and data visualization tools effectively.	Guide students to utilize data science tools and programming languages, such as Python, R, SQL, and data visualization tools effectively. Guide students in coding tasks and projects to use Python, R, SQL, and data visualization tools.	
General Objectives: 4.0 Use machine learning algorithms to build predictive models for various business scenarios						
8-9	4.1 Explain the application of various machine learning algorithms (such as decision trees, support vector machines, k-nearest	Discuss different machine learning algorithms. Conduct guided sessions to demonstrate the	Computers equipped with machine learning software (like Python's scikit-	Apply various machine learning algorithms.	Guide students to implement different machine	Explain the application of various machine learning algorithms (such as decision trees,

	neighbors, and neural networks). 4.2 Explain the performance of predictive models. 4.3 Explain predictive model results	application of these algorithms on real-world business data. Discuss the concept of model evaluation and tuning techniques. Discuss how to present, interpret and communicate predictive model results.	learn, TensorFlow, PyTorch). Access to a variety of real-world business datasets for practicing machine learning. Access to resources on machine learning algorithms and techniques. Access to resources for effective data presentation and communication.	Apply the appropriate machine learning algorithm to a given business scenario for prediction tasks. Evaluate and tune the performance of the predictive models	learning algorithms. Guide students to apply appropriate machine learning algorithm to build a predictive model. Guide students to evaluate and improve their models using tuning techniques.	support vector machines, k-nearest neighbors, and neural networks).
	General Objective: 5.0 Utilize data visualization tools to effectively communicate data-driven insights					
10-11	5.1 Explain the principles of effective data visualization. 5.2 Explain data visualization and communication style for different audiences.	Discuss the principles of effective data visualization. Discuss the use of data visualization tools through live coding sessions or workshops.	Computers with visualization software installed (such as Tableau, PowerBI, or Python's Matplotlib/Seaborn libraries).	Apply data visualization tools (such as Tableau, PowerBI, or Matplotlib in Python) to create clear, accurate,	Guide students to use data visualization tools to present data.	Explain the principles of effective data visualization.

	5.3 Explain visualizations for their clarity, accuracy, and ethical implications.	Discuss tailoring visualizations and communication to different audiences. Discuss critical analysis of real-world data visualizations	Access to various datasets for visualization practice. Course materials or resources on principles of effective data visualization. Examples of real-world data visualizations for analysis.	and compelling visualizations. Analyze visualizations for their clarity, accuracy, and ethical implications.	Guide students to adjust their visualizations and communication style to suit different audiences. Guide students on how to critically evaluate real-world data visualizations	
General Objective 6.0: Understand the ethical and privacy issues related to big data in Artificial Intelligence
12	6.1 Explain the ethical concerns and privacy issues in data science and artificial intelligence. 6.2 Explain the principles of data ethics in various data science tasks. 6.3 Explain data protection strategies.	Discuss ethical concerns and privacy issues in data science and artificial intelligence. Discuss principles of data ethics in real-world situations. Discuss strategies for data privacy protection during practical coding sessions.	Course materials or resources on data ethics, privacy issues, and bias in AI. Case studies highlighting ethical and privacy issues in data science and AI. Computers with necessary software	Apply principles of data ethics in various data science tasks. Implement strategies for protecting data privacy.	Guide students to apply principles of data ethics in various data science tasks. Guide students to implement strategies for	Address biases in datasets and machine learning algorithms

			installed for data handling and privacy protection. Datasets exhibiting different kinds of biases for discussion and analysis.		protecting data privacy.	
	6.4 Explain biases in datasets and machine learning algorithms	Discuss biases in datasets and machine learning algorithms, including their potential effects and mitigation strategies		Address biases in datasets and machine learning algorithms	Guide students to identify, analyze, and mitigate biases in given datasets	
General Objective 7.0: Design a data science project that addresses a real-world business problem						
13-15	7.1 Explain different business problems that can be handled by artificial intelligence 7.2 Explain the usage of AI in solving business problems 7.3 Explain the different types of biases in AI and their impacts. 7.4 Explain strategies for detecting and mitigating bias.	Discuss different business problems that can be handled by artificial intelligence Discuss the usage of AI in solving business problems Discuss the different types of biases in AI and their impacts. Explain strategies for detecting and mitigating bias. Organize group projects and presentations on ethical implications and	Access to relevant literature, industry reports, and databases for identifying business problems. Project management tools for planning and monitoring the project. Computers with necessary data science software installed for project implementation. Presentation tools and equipment for communicating the results.	Identify a real-world business problem that can be addressed using data science techniques. Formulate a research question and design a data science project plan to address the problem.	Guide students in identifying appropriate business problems and formulating research questions. Mentor students in the creation of project plans, ensuring they're feasible and methodologically sound.	Explain the usage of AI in solving business problems

		biases in real-world AI applications.		Implement project on data collection, cleaning, analysis, modeling, and interpretation of results.	Guide students to implement project on data collection, cleaning, analysis, modeling, and interpretation of results.	
				Present the findings in a clear and understandable manner to both technical and non-technical audiences.	Guide students to communicate their findings effectively Guide students to brainstorm during project planning process. Guide students to implement project	

				Guide students to present project results and assess feedback	

AI Development Frameworks

Programme: Higher National Diploma Artificial Intelligence	Course Code: AIT 324	Contact Hours: 4 hours/week
Course Title: AI Development Frameworks	Semester: 2	Theoretical: 2 hours /week
Year: 1 Semester: 2	Pre-requisite: NIL	Practical: 2 hours/week
Credit Units: 4		
Goal: This course is designed to provide students with skills to utilize various artificial intelligence frameworks.		
General Objectives: On completion of this course the student should be able to: 1.0 Understand AI Development Frameworks 2.0 Comprehend AI Development Frameworks Concepts and Principles 3.0 Apply AI Development Frameworks. 4.0 Analyze the Performance of AI Models 5.0 Evaluate AI Development Framework Suitability 6.0 Solve Real World Problems Using AI Development Frameworks. 7.0 Comprehend Adaptation of AI Development Frameworks.		

PROGRAMME: HIGHER NATIONAL DIPLOMA ARTIFICIAL INTELLIGENCE						
Course: AI Development Frameworks		**COURSE CODE:** AIT 324		**Contact Hours:** 4 hours/week		
Credit Units:4		**Pre-Requisite: Nil**		**Theoretical:** 2 hours /week		
				Practical: 2 hours/week		
Goal: This course is designed to provide students with skills to utilize various Artificial Intelligence frameworks						
COURSE SPECIFICATION: Theoretical Contents				**Practical Contents**		
General Objective: 1.0 Understand AI Development Frameworks						
WEEK	**Specific Learning Outcomes**	**Teachers Activities**	**Learning Resources**	**Specific Learning Outcomes**	**Teachers Activities**	**Evaluation**
1	1.1 Describe the salient features of TensorFlow 2.0 and MindSpore. 1.2 Explain the` use-cases of TensorFlow 2.0 and MindSpore. 1.3 Explain the unique aspects of TensorFlow 2.0 and MindSpore.	Explain the fundamental features of TensorFlow 2.0 and MindSpore. Explain the differences in use-cases between TensorFlow 2.0 and MindSpore Discuss the unique characteristics and advantages of TensorFlow 2.0 and MindSpore over other AI development frameworks.	PowerPoint slides, Online Course Material, TensorFlow 2.0 software, MindSpore software Case studies, Online Course Material, Internet for research TensorFlow 2.0 documentation, MindSpore documentation, Online Course Material	Use the primary features of TensorFlow 2.0 and MindSpore Analyze the differences between the use-cases of TensorFlow 2.0 and MindSpore Utilize the unique aspects of TensorFlow	Guide students on how to navigate and interact with the TensorFlow 2.0 and MindSpore frameworks on the computer. Guide students on how to conduct research and evaluate different use-cases of	Explain the unique aspects of TensorFlow 2.0 and MindSpore.

				2.0 and MindSpore in a practical scenario.	TensorFlow 2.0 and MindSpore. Guide students to employ the unique aspects of TensorFlow 2.0 and MindSpore in solving an AI task.	
General Objectives:2.0 Comprehend AI Development Frameworks Concepts and Principles						
4-5	2.1 Explain the key concepts and principles of TensorFlow 2.0 and MindSpore. 2.2 Explain the functionalities of TensorFlow 2.0 and MindSpore. 2.3 Classify different libraries associated with TensorFlow 2.0 and MindSpore.	Explain principles and concepts of TensorFlow 2.0 and MindSpore. Discuss the major functionalities provided by TensorFlow 2.0 and MindSpore. Explain various libraries associated with TensorFlow 2.0 and MindSpore.	PowerPoint slides, Online Course Material, TensorFlow 2.0 software, MindSpore software TensorFlow 2.0 documentation, MindSpore documentation, Online Course Material TensorFlow 2.0 and MindSpore Libraries	Use the key concepts and principles of TensorFlow 2.0 and MindSpore. Use the Various functionalities of TensorFlow 2.0 and MindSpore in a practical setting.	Guide students to use of the key principles and concepts of TensorFlow 2.0 and MindSpore. Guide students to employ the functionalities of TensorFlow 2.0 and MindSpore to perform AI tasks.	Explain various libraries associated with TensorFlow 2.0 and MindSpore.

			documentation, Online Course Material	Use the different libraries associated with TensorFlow 2.0 and MindSpore.	Supervise students as they perform tasks using different libraries of TensorFlow 2.0 and MindSpore.	
	General Objective 3.0: Apply AI Development Frameworks.					
6-9	3.1 Describe the process of designing and developing AI models using TensorFlow 2.0 and MindSpore. 3.2 Explain how to implement AI models using TensorFlow 2.0 and MindSpore. 3.3 Explain the process of testing AI models using TensorFlow 2.0 and MindSpore.	Explain the steps involved in designing and developing AI models using TensorFlow 2.0 and MindSpore. Discuss how AI models can be implemented using TensorFlow 2.0 and MindSpore, using real-world examples Discuss steps involved in testing AI models using TensorFlow 2.0 and MindSpore.	PowerPoint slides, Online Course Material, TensorFlow 2.0 software, MindSpore software, Sample datasets TensorFlow 2.0 and MindSpore documentation, Online Course Material TensorFlow 2.0 and MindSpore documentation, Online Course Material, Testing datasets	Design an AI model using TensorFlow 2.0 and MindSpore Implement an AI model using TensorFlow 2.0 and MindSpore. Test an AI model using TensorFlow 2.0 and MindSpore	Guide students to design and develop AI models using TensorFlow 2.0 and MindSpore. Guide students to implement an AI model using TensorFlow 2.0 and MindSpore. Supervise students as they perform tasks	Explain the process of testing AI models using TensorFlow 2.0 and MindSpore.

					involving the testing of AI models using TensorFlow 2.0 and MindSpore.	
General Objective 4.0: Analyze the Performance of AI Models						
10-12	4.1 Explain how to evaluate the performance of AI models developed using TensorFlow 2.0 and MindSpore. 4.2 Explain how to analyze the performance results of AI models. 4.3 Explain how to interpret the performance results of AI models. 4.4 Describe how to suggest enhancements for the performance of AI models using TensorFlow 2.0 and MindSpore.	Discuss various performance metrics and how to measure the performance of AI models using TensorFlow 2.0 and MindSpore. Explain how to interpret the results of performance metrics and the implications of the results on the AI model. Discuss how to interpret performance results. Discuss different techniques and strategies for improving the performance of AI models.	PowerPoint slides, Online Course Material, TensorFlow 2.0 software, MindSpore software, AI model performance evaluation tools PowerPoint slides, Online Course Material, Performance metric results PowerPoint slides, Online Course Material, TensorFlow 2.0 software, MindSpore software, AI model enhancement tools	Evaluate the performance of an AI model developed using TensorFlow 2.0 and MindSpore. Analyze the performance results of an AI model developed using TensorFlow 2.0 and MindSpore. Interpret the performance results of an AI	Guide students to evaluate the performance of AI models using TensorFlow 2.0 and MindSpore. Guide students to analyze and interpret the performance results of AI models using TensorFlow 2.0 and MindSpore.	Explain how to analyze the performance results of AI models.

				model developed using TensorFlow 2.0 and MindSpore		
				Enhance the performance of an AI model developed using TensorFlow 2.0 and MindSpore.	Supervise students as they apply enhancement techniques to improve the performance of AI models using TensorFlow 2.0 and MindSpore.	
General Objective: 5.0: Evaluate AI Development Framework Suitability						
13	5.1 Explain how to evaluate the efficiency, scalability, and compatibility of TensorFlow 2.0 and MindSpore. 5.2 Explain the suitability of TensorFlow	Discuss the factors of efficiency, scalability, and compatibility and how they apply to TensorFlow 2.0 and MindSpore. Explain the differences in suitability for these tasks.	PowerPoint slides, Online Course Material, TensorFlow 2.0 software, MindSpore software Case studies, Online Course	Evaluate the efficiency, scalability, and compatibility of an AI model developed using TensorFlow 2.0 and MindSpore.	Guide students to evaluate the efficiency, scalability, and compatibility of AI models using TensorFlow 2.0 and MindSpore.	Evaluate the effectiveness of machine learning solutions in given case studies

	2.0 and MindSpore for specific tasks. 5.3 Explain how to justify their choice of AI development framework for a specific task.	Discuss different scenarios where one AI development framework might be more appropriate than the other.	Material, Internet for research PowerPoint slides, Online Course Material, TensorFlow 2.0 software, MindSpore software	Determine the suitability of TensorFlow 2.0 and MindSpore for specific tasks through real-world examples.	Guide students to evaluate different tasks and determine the suitability of TensorFlow 2.0 and MindSpore for these tasks.	
General Objective 6.0: Solve Real-World Problems Using AI Development Frameworks.						
14	6.1 Explain how to plan, develop, and deploy AI solutions using TensorFlow 2.0 and MindSpore. 6.2 Explain how to analyze real-world problems that can be solved using AI solutions developed with TensorFlow 2.0 and MindSpore. 6.3 Explain the	Discuss the steps involved in the planning, development, and deployment of AI solutions using TensorFlow 2.0 and MindSpore. Use case studies to illustrate real-world problems that can be solved using AI. Explain how to implement and test 1xxAI solutions.	PowerPoint slides, Online Course Material, TensorFlow 2.0 software, MindSpore software Case studies, Online Course Material, Internet for research TensorFlow 2.0 and MindSpore documentation, Online Course Material, Testing datasets	Design an AI solution using TensorFlow 2.0 and MindSpore Deploy an AI solution using TensorFlow 2.0 and MindSpore. Identify a real-world problem and propose an AI solution using TensorFlow 2.0 or MindSpore.	Guide students to design, develop, and deploy AI solutions using TensorFlow 2.0 and MindSpore. Guide students to identify real-world problems and design AI solutions using TensorFlow 2.0 and MindSpore. Guide students to	Analyze real-world problems that can be solved using AI solutions developed with TensorFlow 2.0 and MindSpore.

	problems that can be solved using AI.			Implement their AI solution to a real-world problem using TensorFlow 2.0 or MindSpore.	implement and test their AI solutions using TensorFlow 2.0 and MindSpore.	
General Objective 7.0 Comprehend Adaptation of AI Development Frameworks.						
15	7.1 Explain how to incorporate new advancements into their existing projects.	Explain how to incorporate new advancements into their existing projects. Discuss how to adapt existing projects to use the latest advancements.	Recent literature, Blogs, Articles, Online Course Material TensorFlow 2.0 and MindSpore documentation, Online Course Material Student projects, Presentation equipment	Adapt projects to include the latest advancements in TensorFlow 2.0 and MindSpore. Demonstrate continuous learning by presenting a project that effectively uses the latest advancements in TensorFlow 2.0 and MindSpore.	Guide students to update and adapt their projects to include the latest advancements in TensorFlow 2.0 and MindSpore. Guide students to showcase their projects.	Explain how to incorporate new advancements into their existing projects.

Neural Computation and Bioinformatics

Programme: Higher National Diploma Artificial Intelligence	Course Code: AIT 325	Contact Hours: 4 hours/week
Course Title: Neural Computation and Bioinformatics		Practical: 2 hours /week
Year: 1	Pre-requisite: AIT 313	Theoretical: 2 hours/week
Credit Unit: 3	Semester: 2	
Goal: This course is designed to provide students with an understanding of the principles and applications of neural networks and computational techniques to analyze biological data		
General Objectives: On completion of this course the student should be able to: 1.0 Understand Neural Network Fundamentals 2.0 Comprehend Different Neural Network Architectures 3.0 Understand Neural Network Optimization Techniques, Transfer Learning and Pre-trained Models 4.0 Understand Neural Network Applications 5.0 Comprehend Neural Network Interpretability 6.0 Understand Bioinformatics Basics 7.0 Understand the Application of Neural Networks in Bioinformatics		

PROGRAMME: HIGHER NATIONAL DIPLOMA ARTIFICIAL INTELLIGENCE						
Course: Neural Computation and Bioinformatics		**COURSE CODE: AIT 325**			**Contact Hours:** 4 hours/week	
Credit Units: 3		**Pre-Requisite: Nil**			**Theoretical:** 2 hours /week	
					Practical: 2 hours /week	
Goal: This course is designed to acquaint students with an understanding of the principles and applications of neural networks and computational techniques to analyze biological data						
COURSE SPECIFICATION: Theoretical Contents:				**Practical Contents:**		
	General Objective: 1.0 Understand Neural Network Fundamentals					
WEEK	**Specific Learning Outcome**	**Teachers Activities**	**Learning Resources**	**Specific Learning Outcomes**	**Teachers Activities**	**Evaluation**
1-3	1.1 Explain the Concept of Neural Network. 1.2 Explain the different Neurons Activation Functions. 1.3 Explain Forward and Backward Propagation. 1.4 Explain Learning Algorithms	Explain neural network fundamentals. Discuss the different neural network activation functions. Discuss the different neural learning algorisms.	Textbooks and Research Papers. Neural Network Libraries, such as TensorFlow or PyTorch. MATLAB, SIMULINK, and Google Colab.	Execute a Neural Network Projects. Use Model Optimization and Fine-tuning techniques Optimize and fine-tune neural networks hyper	Guide students to design and implement neural network models to solve various tasks, such as image classification or natural language processing Guide students to optimize and fine-tune neural networks hyper parameters to achieve better	Explain the different Neurons Activation Functions.

				parameters to achieve better model performance	model performance.	
General Objectives:2.0 Comprehend Different Neural Network Architectures						
4	2.1 Explain various neural network architectures 2.2 Explain Convolutional neural networks (CNNs). 2.3 Explain Recurrent Neural Networks (RNNs) 2.4 Explain Generative Adversarial Networks (GANs).	Explain the different neural network architecture. Discuss the different neural models such as; ANN, EANN, CNN, RNN, and GAN.	Textbooks and Research Papers. Neural Network Libraries, such as TensorFlow or PyTorch. MATLAB, SIMULINK, and Google Colab.	Use CNN, ANN, EANN, RNN, or GAN to solve real-world problem	Guide students to use CNN, ANN, EANN, RNN, or GAN	
General Objective 3.0: Understand Neural Network Optimization Techniques, Transfer Learning and Pre-trained Models						
5-6	3.1 Explain optimization techniques, such as gradient descent, stochastic gradient descent. 3.2 Explain Advanced optimization algorithms	Explain optimization techniques: - gradient descent, - stochastic gradient descent. Explain Advance optimization such as;	Textbooks and Research Papers. Neural Network Libraries, such as TensorFlow or PyTorch.	Use gradient descent, stochastic gradient descent to optimize the following CNN, ANN, EANN, RNN, or GAN to solve real-world problem	Guide students to use gradient descent, stochastic gradient descent to optimize the following CNN, ANN, EANN, RNN, or GAN to	Explain Advanced optimization algorithms

		Adam for training neural networks.	MATLAB, SIMULINK, and Google Colab.		solve real-world problem	
General Objective 4: Understand Neural Network Applications						
7-8	4.1 Explain various neural networks applications. 4.2 Explain image recognition and natural language processing. 4.3 Explain speech recognition and time series prediction.	Discuss the different neural networks applications. Discuss the image recognition in machine learning (ML) and natural language processing. Discuss time series prediction and speech recognition in AI	Textbooks and Research Papers. Neural Network Libraries, such as TensorFlow or PyTorch. MATLAB, SIMULINK, and Google Colab.	Apply different neural network applications. Apply ML to process images Apply ML to process Natural Languages and time series predictions.	Use MATLAB, SIMULINK, and Google colab to apply neural network to address real-world problems.	Evaluate the different neural network applications developed by the students, and compare the various time series predictions produce by the neural models.
General Objective: 5.0 Comprehend Neural Network Interpretability**.**						
9-10	5.1 Explain neural network interpretability. 5.2 Explain the different methods used to interpret neural network decisions.	Discuss neural network interpretation with real-world examples. Discuss the different methods employed to interpret decisions obtained from neural network algorithms, and how to gain an	Textbooks and Research Papers. Neural Network Libraries, such as TensorFlow or PyTorch etc. MATLAB, SIMULINK, and Google Colab.	Use different machine learning algorithms to carry out features selection	Guide students to use different machine learning algorithms to carry out features selection	Evaluate students' practical projects based on their implementation, model performance, and ability to solve the

	5.3 Explain how to gain insights into the learned representations and features.	insight into the features and other learned representations produced by the network.				designated tasks.

General Objective 6.0: Understand Bioinformatics Basics

| 11-12 | 6.1 Explain the concepts of Bioinformatics.

6.2 Explain biological data types and sequence analysis.

6.3 Explain molecular structure prediction | Discuss the concept of Bioinformatics in Neural network.

Discuss the different Bioinformatics datasets, processing techniques and sequence analysis

Discuss the various modular structure predictions. | MATLAB, SIMULINK, TensorFlow or Keras Google Colab.

Bioinformatics databases like NCBI, and UniProt. | Use machine learning techniques to carry out molecular structure predictions in Bioinformatics | Guide students to use machine learning techniques to carry out molecular structure predictions in Bioinformatics | Explain biological data types and sequence analysis. |

General Objective 7.0: Understand the Application of Neural Networks in Bioinformatics**.**

| 13-15 | 7.1 Explain the usage of neural network in Bioinformatics.

7.2 Explain Bioinformatics protein structure prediction. | Discuss how neural networks are used in bioinformatics for tasks such as protein structure prediction, gene expression analysis, and functional annotation. The general concept of | MATLAB, SIMULINK, TensorFlow or Keras Google Colab.

Bioinformatics databases like NCBI, and UniProt | Implement neural network models in Bioinformatics projects | Guide students to implement neural network models in Bioinformatics projects | Evaluate students' bioinformatics projects based on their implementation, model performance, and ability to |

	7.3 Explain gene expression analysis, and functional annotation.	Bioinformatics in Neural network. Discuss the different Bioinformatics datasets, processing techniques and sequence analysis in order to prepare data for neural network.				address specific bioinformatics challenges.

PROGRAMME: HIGHER NATIONAL DIPLOMA ARTIFICIAL INTELLIGENCE		
COURSE TITLE: Natural Language Processing (NLP)	**Course Code: AIT 326**	**Contact Hours:** 4 hours/week
CREDIT UNIT: 3	**PRE-REQUISITE: Nil**	**Practical:** 2 hours /week
YEAR: ONE	**SEMESTER: TWO**	**Theoretical:** 2 hours/week
GOAL: This course is designed to provide students with skills required to apply Natural Language Processing (NLP) algorithms for various applications.		
General Objectives: On completion of the course, the student should be able to: 1.0 Understand the fundamentals of Natural Language Processing and its applications in various fields. 2.0 Comprehend and implement fundamental linguistic concepts 3.0 Understand the key NLP techniques. 4.0 Understand different machine learning translation models and sentiment analysis 5.0 Understand the application of machine learning and deep learning algorithms to improve NLP tasks. 6.0 Comprehend the performance of various NLP models and their optimization. 7.0 Understand and navigate ethical and bias considerations in NLP.		

PROGRAMME: HIGHER NATIONAL DIPLOMA ARTIFICIAL INTELLIGENCE						
Course: Natural Language Processing (NLP)		**COURSE CODE: AIT 326**			**Contact Hours:** 4 hours /week	
Credit Units: 3		**Pre-Requisite: Nil**			**Theoretical:** 2 hours /week	
					Practical: 2 hours /week	
GOAL: This course is designed to equip students with knowledge and skills necessary to understand, design, and apply NLP algorithms in various applications.						
COURSE SPECIFICATION: Theoretical Contents:				**Practical Contents:**		
General Objective: 1.0 Understand the fundamentals of Natural Language Processing and its applications in various fields.						
WEEK	**Specific Learning Outcomes**	**Teachers Activities**	**Learning Resources**	**Specific Learning Outcomes**	**Teachers Activities**	**Evaluation**
1-2	1.1 Explain the basic concepts and terminologies in NLP. 1.2 Explain the applications of NLP in various fields such as healthcare, finance, and customer service. 1.3 Explain the challenges and limitations in NLP.	Discuss NLP fundamentals. Discuss NLP applications. Discuss NLP challenges and limitations.	Computer with internet access and projector for presenting lectures. Case study materials and resources. Debate topics and resources. Software tools for NLP demonstrations such as Python with NLTK or Spacy libraries	Use applications of NLP in various fields such as healthcare, finance, and customer service. Use NLP in machine learning and information retrieval.	Guide students to use applications of NLP in various fields such as healthcare, finance and customer service. Guide students to provide feedback and additional insights. Guide students to use NLP for information retrieval and	Explain the basic concepts and terminologies in NLP.

	1.4 Describe the role of NLP in information retrieval and machine learning	Discuss NLP in machine learning and information retrieval			machine learning.	
General Objective 2.0: Comprehend and implement fundamental linguistic concepts						
3-5	2.1 Define morphology, syntax, semantics, and pragmatics.

2.2 Explain the differences between morphology, syntax, semantics, and pragmatics.

2.3 Explain the linguistic analysis methods in NLP projects.

2.4 Explain linguistic concepts to improve machine understanding of human language. | Discuss fundamental linguistic concepts. Explain linguistic analysis methods to text data.

Discuss how linguistic concepts can improve machine understanding through examples. | Computer with internet access and projector for presenting lectures. Access to NLP software (Python, NLTK, Spacy) for lab sessions. Examples and resources illustrating the application of linguistic concepts. Computing resources for training language models | Apply knowledge of semantics and pragmatics in the construction of language models.

Implement linguistic analysis methods in NLP projects. Utilize linguistic concepts to improve machine understanding of human language. | Guide students during lab sessions to implement linguistic analysis.

Guide students to apply linguistic concepts in their projects. Guide students work in building language models, giving feedback and additional inputs. | Distinguish between morphology, syntax, semantics, and pragmatics. |

		General Objective 3.0: Understand the key NLP techniques					
6-8	3.1 Explain tokenization in different language contexts. 3.2 Explain part-of-speech tagging and understand its significance in NLP. 3.3 Explain named entity recognition on different types of text data.	Discuss the concept of tokenization with examples Discuss how to perform named entity recognition. Discuss process of syntactic parsing and interpretation of results	Computer with internet access and projector for delivering lectures. NLP software (Python, NLTK, Spacy) for practical sessions. Datasets for named entity recognition and syntactic parsing.	Perform syntactic parsing and interpret the results for further text analysis Implement part-of-speech tagging and understand its significance in NLP. Conduct named entity recognition on different types of text data. Provide feedback and guidance during syntactic parsing activities	Guide students through the process of syntactic parsing and interpretation of results Guide students to implement part-of-speech tagging. Guide students to conduct named entity recognition on provided datasets. Guide students to provide feedback and guidance during syntactic parsing activities.	Explain named entity recognition on different types of text data.

		General Objectives: 4.0 Understand different machine learning translation models and sentiment analysis				
9-10	4.1 Explain basic principles of machine translation and its applications. 4.2 Explain machine translation models using standard NLP libraries. 4.3 Explain the process of sentiment analysis and its uses. 4.4 Explain models for sentiment analysis.	Discuss machine translation, its history, principles, and applications. Discuss the process of designing and implementing machine translation models using examples. Discuss the concept of sentiment analysis and its importance in data analytics. Discuss various other NLP tasks and the models used to tackle them.	Computer projector NLP software and libraries (Python, NLTK, Spacy, Tensorflow, PyTorch) Datasets	Use machine translation models to build NLP projects using standard NLP libraries Develop and train models for sentiment analysis.	Guide students to use machine translation models to build NLP projects using standard NLP libraries Guide students to develop and train models for sentiment analysis	Explain basic principles of machine translation and its applications.

	General Objective 5.0: Understand the application of machine learning and deep learning algorithms to improve NLP tasks.				
11-12	5.1 Explain the principles of machine and deep learning as applied to NLP. 5.2 Explain machine learning algorithms for text classification, topic modeling, and other NLP tasks. 5.3 Explain deep learning methods for NLP tasks such as word embeddings and sequence-to-sequence models. 5.4 Explain the performance and accuracy of machine learning and deep learning models on NLP tasks.	Discuss machine and deep learning principles and how they're applied in NLP. Discuss machine learning algorithms for NLP tasks. Discuss deep learning methods for various NLP tasks.	Computer systems with internet access and a projector for lectures. NLP and machine learning/deep learning software libraries (Python, Scikit-learn, TensorFlow, Keras, etc). Relevant text datasets for machine learning and deep learning practice.	Apply machine and deep learning algorithms for NLP tasks. Use machine and deep learning algorithms for text classification, topic modeling, and other NLP tasks. Apply deep learning methods for NLP tasks such as word embeddings and sequence-to-sequence models. Evaluate the performance and accuracy of machine learning and deep learning models on NLP tasks.	Guide students on evaluating the performance of deep learning models and interpreting results. Guide students to apply machine and deep learning algorithms to NLP tasks. Guide students to evaluate the performance and accuracy of their models.	

General Objective 6.0: Comprehend the performance of various NLP models and their optimization

13-14	6.1 Explain various performance metrics used to evaluate NLP models.	Discuss different performance metrics used in NLP.	Computer systems with internet access and a projector for lectures.	Evaluate the performance of different NLP models.	Guide students to evaluate NLP models.	Explain optimization techniques to improve the performance of NLP models.
	6.2 Explain the performance of different NLP models.	Discuss how to evaluate NLP models.	NLP and machine learning/deep learning software libraries (Python, Scikit-learn, TensorFlow, Keras, etc).	Apply optimization techniques to improve the performance of NLP models.	Guide students in applying optimization techniques to NLP models	
	6.3 Explain optimization techniques to improve the performance of NLP models.	Discuss optimization techniques.	Relevant text datasets for practicing model evaluation and optimization.	Use validation sets, cross-validation, and other techniques to assess and improve model performance.	Guide students to apply techniques like cross-validation to assess and improve model performance.	
	6.4 Explain validation sets, cross-validation, and other techniques used to assess and improve model performance.					

General Objective 7.0: Understand ethical and bias considerations in NLP.					
15	7.1 Explain the ethical considerations in the use and development of NLP technologies. 7.2 Explain different types of biases that can affect NLP systems and their potential impacts. 7.3 Explain strategies to detect and mitigate bias in NLP models. 7.4 Explain ethical implications and biases in real-world NLP applications	Discuss the ethics of artificial intelligence and NLP. Discuss about different types of biases in NLP and their impacts. Discuss strategies for detecting and mitigating bias. Discuss ethical implications and biases in real-world NLP applications.	Computer systems with internet access and a projector for lectures. NLP and machine learning/deep learning software libraries (Python, Scikit-learn, TensorFlow, Keras, etc). Case studies, academic papers, and resources on ethics and bias in NLP.	Apply strategies to detect and mitigate bias Apply ethical implications and biases in real-world NLP applications	Guide students to apply strategies to detect and mitigate bias. Guide students to Apply ethical implications and biases in real-world NLP applications.	Explain different types of biases that can affect NLP systems and their potential impacts.

Research Methodology in AI

PROGRAMME: HIGHER NATIONAL DIPLOMA ARTIFICIAL INTELLIGENCE		
Course: Research Methodology in AI	**Course Code:** AIT 327	**Contact Hours:** 4 Hours/Week
Credit Units: 2	**Pre-requisite: NIL**	**Theoretical:** 2Hours/Week
YEAR: ONE	**SEMESTER; TWO**	**Practical:** 2 Hours/Week
GOAL: This course is designed to provide students with a comprehensive understanding of the fundamental research principles, methodologies, and best practices essential for conducting effective and innovative AI research.		
General Objective: On completion of this course students should be able to: **1.0:** Understand AI Research Landscape. 2.0 Evaluate Research Literature 3.0 Design Robust AI Experiments 4.0 Apply Ethical Research Practices 5.0 Utilize AI Tools and Frameworks 6.0 Collaborate in Research Projects 7.0 Produce High-Quality Research Papers		

PROGRAMME: HIGHER NATIONAL DIPLOMA ARTIFICIAL INTELLIGENCE

Course: Research Methodology in AI	**Course Code:** AIT 327	**Contact Hours:** 4 Hours/Week
Credit Units: 2	**Pre-requisite: NIL**	**Theoretical:** 2Hours/Week **Practical:** 2 Hours/Week

GOAL: This course is designed to provide students with a comprehensive understanding of the fundamental research principles, methodologies, and best practices essential for conducting effective and innovative AI research.

Course Specification: THEORETICAL CONTENT			**PRACTICAL CONTENT**		
General Objective 1.0: Understand AI Research Landscape.					
Week	**Specific Learning Outcome**	**Teachers' Activities**	**Learning Resources**	**Specific Learning Outcome**	**Teachers' Activities**	**Evaluation**
1-2	1.1 Explain the fundamental concepts of AI and its applications. 1.2 Explain key milestones and historical developments in AI research. 1.3 Explain the current state of AI research, including major trends and breakthroughs. 1.4 Explain ethical considerations and	Discuss AI concepts and real-world applications. Discuss timeline of significant events in AI research history and facilitate discussions. Discuss ethical issues in AI research.	Reading materials, case studies, and research papers for students to explore current AI research trends.	Analyze real-world AI projects or case studies and identify their key components and challenges. Develop a simple AI prototype or model using a programming language or AI toolkit.	Guide student to analyze real-world AI projects or case studies and identify their key components and challenges. Guide student to develop a simple AI prototype or model using a programming language or AI toolkit.	Explain the fundamental concepts of AI and its applications. Enumerate key milestones and historical developments in AI research. Explain the current state of AI research, including major trends and breakthroughs.

	challenges related to AI research.					
	1.5 Explain the interdisciplinary nature of AI and its collaboration with other fields	Discuss the interdisciplinary nature of AI and its collaboration with other fields.				
General Objective 2.0: Evaluate Research Literature						
3-4	2.1 Explain key components of research literature.	Discuss key components of research literature, such as abstracts, introductions, methodologies, results, and conclusions.	Reading materials, case studies, and research papers for students to explore current AI research trends.	Evaluate a research paper and present findings in a structured manner.	Guide student to evaluate a research paper and present findings in a structured manner.	Define key components of research literature.
	2.2 Explain the credibility and reliability of research sources and identify potential biases.	Discuss the credibility and reliability of research sources and identify potential biases.		Compare and contrast research methodologies used in two different papers.	Guide student to Compare and contrast research methodologies used in two different papers.	Explain the credibility and reliability of research sources and identify potential biases.
	2.3 Explain the criteria to evaluate the quality and relevance of research articles.	Discuss the appropriate criteria to evaluate the quality and relevance of research articles.		Prepare a literature review by synthesizing information from multiple research articles.	Guide student to Prepare a literature review by synthesizing information from	
	2.4 Explain the strengths and weaknesses of different research methodologies used in the literature.	Discuss the strengths and weaknesses of different research				

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Week						
	methodologies used in the literature.					multiple research articles.
	2.5 Explain how to synthesize information from multiple research papers to form a coherent and well-supported argument.	Discuss how to Synthesize information from multiple research papers to form a coherent and well-supported argument.				
General Objective 3.0: Design Robust AI Experiments						
5-6	3.1 Explain the key components of a robust AI experiment. 3.2 Explain how to formulate research questions suitable for AI experimentation. 3.3 Explain how to select appropriate datasets for AI experiments. 3.4 Explain how to apply relevant machine learning algorithms to solve specific problems.	Discuss the key components of a robust AI experiment. Discuss how to formulate research questions suitable for AI experimentation. Discuss how to select appropriate datasets for AI experiments. Discuss how to apply relevant machine learning algorithms to solve specific problems.	Marker board, Markers, Documentary films, Multimedia Projector and Screen, Case studies, Power point slides, Internet, Textbooks, Computer, Flip charts, Policy documents, research papers, etc.	Apply relevant machine learning algorithms to solve specific problems. Implement proper techniques for model evaluation and validation. Perform ethical considerations in AI experiment design.	Guide student to apply relevant machine learning algorithms to solve specific problems. Guide student to Implement proper techniques for model evaluation and validation. Demonstrate to student ethical considerations in AI experiment design.	Explain the key components of a robust AI experiment. Formulate research questions suitable for AI experimentation. Explain how to Select appropriate datasets for AI experiments.

| | 3.5 Explain how to analyze and interpret the results of AI experiments. f. Implement proper techniques for model evaluation and validation. | Discuss how to analyze and interpret the results of AI experiments. | | | | |
| | 3.6 Explain ethical considerations in AI experiment design. | Discuss ethical considerations in AI experiment design. | | | | |

General Objective 4.0: Apply Ethical Research Practices

| 7-8 | 4.1 Explain the principles of ethical research and their importance in academic and professional settings.

4.2. Explain potential ethical issues and challenges that may arise during the research process.

4.3 Explain the ethical guidelines and protocols to design, conduct, and report research studies.

4.4. Explain the ethical implications of research findings and propose appropriate solutions. | Discuss ethical research principles, codes and guidelines.

Discuss potential ethical issues and challenges that may arise during the research process.

Discuss the ethical guidelines and protocols to design, conduct, and report research studies.

Discuss the ethical implications of research findings and propose appropriate solutions. | Marker board, Markers, Documentary films, Multimedia Projector and Screen, Case studies, Power point slides, Internet, Textbooks, Computer, Flip charts, Policy documents, research papers, etc. | Develop a research proposal that incorporates ethical considerations.

Conduct practical on ethical review of an existing research study. Prepare an ethical data management plan for a research project. | Guide student to develop a research proposal that incorporates ethical considerations.

Guide student to conduct practical on ethical review of an existing research study.

Guide student to prepare an ethical data management plan for a research project. | Describe the principles of ethical research and their importance in academic and professional settings.

Explain potential ethical issues and challenges that may arise during the research process.

Describe ethical guidelines and protocols to design, conduct, and report research studies. |

	4.5 Explain awareness of the ethical use of data, including privacy, confidentiality, and informed consent.	Discuss awareness of the ethical use of data, including privacy, confidentiality, and informed consent.			
General Objective 5.0: Utilize AI Tools and Frameworks					
9-10	5.1. Explain proficiency in using popular AI tools and frameworks

5.2. Explain AI tools to preprocess data and prepare it for model training and evaluation.

5.3. Explain AI models using the selected frameworks to solve specific problems

5.4. Explain the performance of AI models and fine-tune hyperparameters for optimization. | Discuss proficiency in using popular AI tools and frameworks, such as Mindspor, TensorFlow or PyTorch.

Discuss exercises for data preprocessing tasks using AI tools.

Discuss coding sessions and projects where students build AI models using selected frameworks.

Discuss case studies on model evaluation and hyperparameter tuning. | Marker board, Markers, Documentary films, Multimedia Projector and Screen, Case studies, Power point slides, Internet, Textbooks, Computer, Flip charts, Policy documents, research papers, etc. Mindspor, TensorFlow or PyTorch | Build and train an image classification model using TensorFlow.

Fine-tune a pre-trained natural language processing model with PyTorch.

Implement a simple AI-based recommendation system using a relevant framework. | Guide student to Build and train an image classification model using TensorFlow.

Guide student to fine-tune a pre-trained natural language processing model with PyTorch.

Guide student to Implement a simple AI-based recommendation system using a relevant framework. | Explain AI tools to preprocess data and prepare it for model training and evaluation.
 Explain and train AI models using the selected frameworks to solve specific problems |

	5.5. Explain how to integrate AI models into real-world applications and interpret their outputs.	Discuss AI model integration into applications.				
General Objective 6.0: Collaborate in Research Projects						
11-13	6.1 Explain effective communication and teamwork skills in a research project setting. 6.2 Explain actively to research discussions and propose valuable ideas and insights. 6.3 Explain the management of project timelines. 6.4 Explain data collection, analysis, and interpretation in a research project. 6.5 Explain research findings coherently and professionally to an audience.	Discuss effective communication and teamwork skills in a research project setting. Discuss actively to research discussions and propose valuable ideas and insights. Discuss with peers to divide tasks, set goals, and manage project timelines. Discuss data collection, analysis, and interpretation in a research project. Discuss research findings coherently and professionally to an audience.	Marker board, Markers, Documentary films, Multimedia Projector and Screen, Case studies, Power point slides, Internet, Textbooks, Computer, Flip charts, Policy Mindspor, TensorFlow or PyTorch documents, research papers, etc.	Collaborate in a research project with a team of peers. Conduct data analysis and interpretation as part of the research project Deliver a group presentation on the research project's findings	Assign students to research project teams based on their interests and expertise. Provide guidance and support to student during data analysis and interpretation stages. Guide students to present research project's findings	Explain actively to research discussions and propose valuable ideas and insights. Discuss with peers to divide tasks, set goals, and manage project timelines.

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General Objective 7.0: Produce High-Quality Research Papers					
14-15	7.1 Explain proficiency in conducting comprehensive literature reviews and identifying research gaps. 7.2 Explain well-structured research questions or hypotheses for a research paper. 7.3 Explain appropriate research methodologies and data analysis techniques to answer research questions. 7.4 Explain how to write clear, concise, and well-organized research papers adhering to academic writing conventions 7.5 Explain how to revise and edit research papers based on feedback to improve clarity and coherence	Discuss proficiency in conducting comprehensive literature reviews and identifying research gaps. Discuss well-structured research questions or hypotheses for a research paper. Discuss appropriate research methodologies and data analysis techniques to answer research questions. Discuss how to write clear, concise, and well-organized research papers adhering to academic writing conventions. Discuss how to revise and edit research papers based on feedback to improve clarity and coherence.	Marker board, Markers, Documentary films, Multimedia Projector and Screen, Case studies, Power point slides, Internet, Textbooks, Computer, Flip charts, Policy documents, research papers, etc.			Describe proficiency in conducting comprehensive literature reviews and identifying research gaps. Explain well-structured research questions or hypotheses for a research paper

	7.6 Explain how to carry out a comprehensive literature review for a chosen research topic.				
	7.7 Explain how to formulate clear and focused research questions or hypotheses.				
	7.8 Explain how to write a complete research paper on a specific research topic.				

YEAR TWO SEMESTER ONE COURSES

Deep Learning

Programme: Higher National Diploma Artificial Intelligence	Course Code: 412	Contact Hours: 6 Hours/Week
Course Title: Deep Learning	Credit Units: 3	Theoretical: 2 hour /week
Year: 2 Semester: 1	Pre-requisite: AIT 313	Practical: 4 hour /week
Goal: This course is designed to provide students with deep learning skills		
General Objectives: On completion of this course the student should be able to: 1.0 Comprehend Deep Learning Fundamentals 2.0 Apply Neural Networks 3.0 Comprehend Advanced Deep Learning Techniques 4.0 Comprehend Enhanced Deep Learning Model Performance 5.0 Implement deep learning models on real-world datasets. 6.0 Understand how to leverage pre-trained models and adapt them for new applications.		

PROGRAMME: HIGHER NATIONAL DIPLOMA ARTIFICIAL INTELLIGENCE

Course: Deep Learning		COURSE CODE: AIT 412		Contact Hours: 6 Hours/Week		
Credit Units: 3		**Pre-requisite**		**Theoretical**: 2 hours/week **Practical:** 2 hours/week		
Goal: This course is designed to provide students with deep learning skills						
COURSE SPECIFICATION: Theoretical Contents:			**Practical Contents:**			
	General Objective: 1.0 Understand Deep Learning Fundamentals					
WEEK	**Specific Learning Outcomes**	**Teachers Activities**	**Learning Resources**	**Specific Learning Outcomes**	**Teachers Activities**	**Evaluation**
1-3	1.1 Define deep learning and its significance in AI 1.2 Explain the role of neural networks in deep learning 1.3 Describe the layers and architecture of a neural network 1.4 Explain the role of activation functions 1.5 Explain optimization algorithms in deep learning	Explain deep learning and its significance in AI Explain the role of neural networks in deep learning Describe the layers and architecture of a neural network Explain the role of activation functions Explain optimization algorithms in deep learning	- Textbooks on deep learning concepts. - Online articles on the significance of deep learning in AI. - Online tutorials explaining neural network fundamentals. - Visual resources illustrating neural network architectures. - Online tutorials demonstrating activation function applications.	Set up a Deep Learning Environment Implement a Basic Feedforward Neural Network Build and Train a Convolutional Neural Network (CNN) Use Image Style Transfer using Convolutional Neural Networks	Guide students in installing required software and libraries for deep learning. Guide students to code and train basic feedforward neural network. Guide students to build and train a CNN for image classification	Explain the role of neural networks in deep learning

	1.6 Explain the concept of regularization and its importance 1.7 Explain the structure and organization of neural network layers. 1.8 Explain the various optimization methods. 1.9 Regularize techniques to prevent overfitting.	Explain the concept of regularization and its importance Explain the structure and organization of neural network layers. Discuss gradient descent and various optimization methods. Discuss regularization techniques to prevent overfitting.	- Research papers on optimization algorithms in deep learning. - Articles and tutorials on regularization in deep learning.	Perform Text Generation using Recurrent Neural Networks (RNNs) Fine-tune Pre-trained Models for Image Recognition	Guide students to implement image style transfer using CNNs. Guide students to code and train an RNN for text generation. Guide students to fine-tune a pre-train model for a specific task.	
	General Objectives: 2.0 Apply Neural Networks					
4-5	2.1 Explain the role of neural networks in AI 2.2 Explain the components of a neural network 2.3 Describe the process of forward and backward propagation 2.4 Explain the concept of loss functions and their optimization	Explain the role of neural networks in AI Explain the components of a neural network Describe the process of forward and backward propagation Explain the concept of loss functions and their optimization	- Textbooks on deep learning concepts. - Online articles on the significance of deep learning in AI. - Online tutorials explaining neural network fundamentals. - Visual resources	Implement Feedforward Neural Network for Image Classification Use Text Classification with Recurrent Neural Networks (RNNs) Generate Image using Generative Adversarial	Guide students in coding and training a neural network for image classification. Assist students in building and training an RNN for text classification.	Discuss research papers on AI security and network topics

2.5 Explain techniques for neural network regularization 2.6 Explain how data flows and gradients are computed in neural networks. 2.7 Explain strategies for hyperparameter tuning 2.8 Explain the concept of backpropagation and gradients 2.9 Describe methods to prevent overfitting in neural networks.	Explain techniques for neural network regularization Explain how data flows and gradients are computed in neural networks. Discuss strategies for hyperparameter tuning Explain the concept of backpropagation and gradients Describe methods to prevent overfitting in neural networks.	illustrating neural network architectures. - Online tutorials demonstrating activation function applications. - Articles and tutorials on regularization in deep learning.	Networks (GANs) Use Sentiment Analysis with Convolutional Neural Networks (CNNs) Implement Transfer Learning for Image Recognition Implement Sequence-to-Sequence Models for Language Translation Build a Custom Neural Network for a Specific Task	Guide students in implementing a GAN for image generation. Assist students in building a CNN for sentiment analysis. Guide students in applying transfer learning to a pre-trained model. Assist students in building sequence-to-sequence models for translation. - Supervise students in developing a	

					custom neural network project.	
General Objective 3.0: Comprehend Advanced Deep Learning Techniques					
6-7	3.1 Explain the fundamentals of Convolutional Neural Networks (CNNs) 3.2 Explain the role of CNNs in image analysis 3.3 Describe the structure of Recurrent Neural Networks (RNNs) 3.4 Explain RNN variations 3.5 Explain the concept of generative models 3.6 Explain the working of Generative Adversarial Networks (GANs) 3.7 Describe the concept of Transfer Learning and its application in deep learning	Explain CNN architecture and applications. Discuss how CNNs are used for image recognition tasks. Explain RNN architecture and its sequential data processing. Discuss LSTM and GRU benefits. Explain generative models and their applications. Explain the adversarial training process in GANs.	Textbooks on advanced deep learning techniques. - Online tutorials on CNNs. Research papers on CNN applications in computer vision. Online tutorials on RNNs and sequence modeling. Articles comparing different RNN architectures. Online resources on generative models in deep learning. Research papers on GAN theory and applications.	Classify Image using CNNs Detect Object using Faster R-CNN Generate Sequence with Long Short-Term Memory (LSTM) Implement Text Generation using Recurrent Neural Networks Implement Variational Autoencoders (VAEs)	Guide students in implementing CNNs for image classification. Assist students in implementing Faster R-CNN for object detection. Guide students in building an LSTM-based sequence generator. Assist students in developing RNN-based text generation models. Guide students in	Describe the structure of Recurrent Neural Networks (RNNs)

					implementing GANs for image generation. Assist students in building VAEs for image generation.	
General Objective 4.0: Comprehend Enhanced Deep Learning Model Performance						
8-9	4.1 Explain the concept of model optimization 4.2 Explain the role of regularization in preventing overfitting 4.3 Describe hyperparameter tuning and its impact on model performance 4.4 Discuss gradient descent and its role in model optimization 4.5 Explain the challenges and trade-offs in model optimization	Explain the concept of model optimization Explain the role of regularization in preventing overfitting Describe hyperparameter tuning and its impact on model performance Explain gradient descent and its role in model optimization Explain the challenges and trade-offs in model optimization	Textbooks on model optimization and deep learning. - Online articles on model optimization techniques. Research papers on regularization techniques in deep learning. Online tutorials on hyperparameter optimization methods. Online resources on gradient	Carry out Hyperparameter Tuning for Improved Model Performance Implement Dropout and Regularization Techniques Use Gradient Descent Optimization for Model Training Optimize a Deep Learning Model	Guide students in tuning the hyperparameters of a model. Assist students in implementing dropout and other regularization methods. Guide students in implementing gradient descent for model optimization. Supervise students in	Explain the role of regularization in preventing overfitting

| | | | descent algorithms.

Case studies on model optimization in real-world scenarios. | | optimizing a complex deep learning model. | |
|---|---|---|---|---|---|---|
| | **General Objective:** 5.0 Implement deep learning models on real-world datasets. | | | | | |
| **10-12** | 5.1 Explain AI Bias and Its Impact

5.2 Explain Biases in AI Algorithms

5.3 Explain Fairness Metrics for AI Decision-making

5.4. Explain Strategies to Mitigate Bias in AI Applications

5.5 Explain Ethical Considerations in AI Bias and Fairness | Explain AI bias, its types, and consequences.

Discuss biases in AI algorithms and models.

Explain fairness metrics used in AI decision-making.

Discuss strategies to mitigate bias in AI applications.

Discuss ethical considerations in AI bias and fairness. | Textbooks on AI bias and fairness.

Research papers on AI bias in algorithms.

Guidelines for fairness evaluation in AI.

Case studies on bias mitigation in AI.

Ethical guidelines for AI bias and fairness. | Carry out Bias Detection in AI Datasets

Carry out Bias Mitigation Strategies in AI Models
Carry out Fairness Evaluation in AI Systems

Carry out Fairness Analysis in AI Decision-making | Guide students in detecting bias in AI datasets.

Assist students in implementing bias mitigation strategies.

Conduct fairness evaluations of AI systems.

Guide students in developing fairness-aware AI models. | |

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General Objective 6.0: Understand how to leverage pre-trained models and adapt them for new applications.

13-15	6.1 Explain the concept of transfer learning 6.2 Describe the process of leveraging pre-trained models 6.3 Explain the different architectures for transfer learning 6.4 Explain the concept of feature extraction in transfer learning 6.5 Explain the challenges and considerations in transfer learning	Explain transfer learning and its applications. Explain how to adapt pre-trained models for new tasks. Explain various pre-trained architectures like VGG, ResNet, BERT. Discuss how to extract meaningful features from pre-trained models. Explain the challenges and considerations in transfer learning	Textbooks on transfer learning in deep learning. – Online articles on the benefits of transfer learning. Online tutorials on using pre-trained models in deep learning. Visual resources illustrating different pre-trained architectures. Research papers on feature extraction methods in transfer learning. Case studies on successful transfer learning applications.	Fine-tune a Pre-trained Image Classification Model Adapt a Language Model for Text Generation Fine-tune a Pre-trained Object Detection Model	Guide students in fine-tuning a pre-trained model for image classification. Assist students in adapting a pre-trained language model for text generation. Guide students in fine-tuning a pre-trained object detection model. Supervise students in adapting a pre-trained model for a domain-specific problem.	Explain the different architectures for transfer learning

Soft and Quantum Computing

Programme: Artificial Intelligence (Higher National Diploma)	Course Code: 413	Contact Hours: 4Hours/week
Course Title: Soft and Quantum Computing	Credit Units: 3	Theoretical: 2 hour /week
Year: 2 Semester: 1	Pre-requisite: AIT 313	Practical: 2 hour /week
Goal: This course is designed to provide students with knowledge and skills of soft computing and quantum techniques		
General Objectives: On completion of this course the student should be able to: 1.0 Understand Soft Computing Concepts 2.0 Apply Soft Computing Techniques 3.0 Comprehend Fuzzy Logic Applications 4.0 Comprehend Evolutionary Algorithms for Optimization 5.0 Understand Quantum Computing Fundamentals 6.0 Comprehend Application of Soft and Quantum Computing 7.0 Understand Quantum Algorithms and Applications		

PROGRAMME: HIGHER NATIONAL DIPLOMA ARTIFICIAL INTELLIGENCE

Course: Soft and Quantum Computing	COURSE CODE: AIT 413	Contact Hours: 4 Hours/Week
Credit Units: 3	Pre-requisite: Nil	Theoretical: 2 hours/week
		Practical: 2 hours/week

Goal: This course is designed to provide students with knowledge of soft computing and quantum techniques

COURSE SPECIFICATION: Theoretical Contents:		Practical Contents:

General Objective: 1.0 Understand Soft Computing Concepts

WEEK	Specific Learning Outcomes	Teachers Activities	Learning Resources	Specific Learning Outcomes	Teachers Activities	Evaluation
1-3	1.1 Explain the concept soft computing methodologies. 1.2 Explain the concept of Fuzzy sets. 1.3 Explain the concept of genetic algorithms, and particle swarm optimization.	Explain the basic concepts of soft computing. Explain the concept of Fuzzy logic, neural networks, and evolutionary algorithms. Explain how Genetic Algorithms (GA) and Particle Swarm Optimization (PSO) techniques can be used to solve optimization problems.	MATLAB, SIMULINK, Google Colab, and Python libraries (e.g., scikit-fuzzy, TensorFlow, PyTorch). Research papers on	Use Hybrid Soft Computing Approaches. Develop hybrid systems for more effective problem-solving.	Guide students to use Hybrid Soft Computing Approaches Guide Students to combine different soft computing methodologies to develop hybrid systems for more effective problem-solving.	Explain the concept of Fuzzy logic, neural networks, and evolutionary algorithms.

General Objectives: 2.0 Apply Soft Computing Techniques						
4-5	2.1 Explain the concept of different soft computing integration techniques. 2.2 Explain how to integrate various soft computing techniques to solve complex real-world problems effectively. 2.3 Explain the concept of Validation and Testing ML.	Explain the concept soft computing, soft computing techniques, and integration. Explain the different Ensemble methods, such as stacking, bagging, or boosting on how to enhance the overall model. Explain the different Testing and Validation techniques such as; cross-validation, and hold-out validation.	MATLAB, Python Libraries, R Programming, Juzzy,	Apply Fuzzy-Neural Hybrid techniques to solve real-world problems	Guide students to apply Fuzzy-Neural Hybrid techniques to solve real-world problems	Explain the concept of Validation and Testing ML.
General Objective 3.0: Comprehend Fuzzy Logic Applications						
6-7	3.1 Explain the applications of Fuzzy logic in decision-making. 3.2 Explain Fuzzy Set Theory, Fuzzy Logic System Design, and Fuzzy Inference Implementation.	Explain the concept of Fuzzy logic applications, and its uses in decision making. Explain membership functions, fuzzy operations, and linguistic variables, using real-world examples for better understanding.	MATLAB Fuzzy Logic Toolbox, scikit-fuzzy and fuzzy wuzzy for fuzzy logic.	Implement a Fuzzy Logic system Create Hybrid Fuzzy-Neural Systems	Guide students to implement a Fuzzy Logic system Guide students to create Hybrid Fuzzy-Neural Systems.	Explain the concept of Fuzzy logic applications, and its uses in decision making.

	3.3 Explain Fuzzy Control System.	Explain the principles of fuzzy control systems and their applications in managing complex and uncertain environments.				
General Objective 4.0: Comprehend Evolutionary Algorithms for Optimization						
8-10	4.1 Explain the concept of evolutionary algorithms. 4.2 Explain genetic algorithms and genetic programming. 4.3 Explain different optimization tasks.	Explain the principles and mechanics of evolutionary algorithms, such as; genetic algorithms, genetic programming, and particle of swarm optimization. Explain to students how to formulate real-world optimization problems, and fitness functions for applying evolutionary algorithms.	MATLAB's Global Optimization Toolbox for built-in functions related to optimization and genetic algorithms. Python Libraries such as; such as DEAP (Distributed Evolutionary Algorithms in Python), JMetal	Optimize Genetic Algorithm Use Genetic Algorithm and Programming for Symbolic Regression	Guide students to use genetic Algorithm and programming to evolve mathematical expressions that fit given datasets, such as symbolic regression problems.	Explain genetic algorithms and genetic programming
General Objective: 5.0 Understand Quantum Computing Fundamentals						
11-12	5.1 Explain the fundamental principles of quantum computing 5.2 Explain quantum qubits, and quantum	Explain the fundamental principles of quantum computing, such as quantum origin, quantum bits, and how the differs with classical bits.	Qiskit, Cirq, ProjectQ, and Quipper.	Design a Quantum Circuit. Implement Quantum Algorithm	Guide students to design and implement quantum circuits using quantum programming	Explain the fundamental principles of quantum computing

	gates.	Explain superposition, and how qubits exist in a superposition of states, representing both 0 and 1 simultaneously. Explain how quantum gates manipulate qubits to perform quantum operations, such as rotations, phase shifts, and entanglement operations.		Mitigate Quantum Error	frameworks like Qiskit or Cirq.	
	5.3 Explain quantum algorithms, and quantum entanglement.	Explain Quantum algorithms, such as Shor's algorithm for factoring large numbers, and Grover's algorithm for unsorted database search.				
General Objective 6.0: Comprehend Application of Soft and Quantum Computing						
13-14	6.1 Explain the soft and quantum computing techniques. 6.2 Explain the application of soft computing and quantum	Explain how Soft computing techniques, such as fuzzy logic, neural networks, and genetic algorithms, can be combined with quantum computing to address challenges in	MATLAB, Google Colab, Qiskit Aqua, Python libraries such as Quantum Neural Networks in Quantum Machine Learning (QML).			Explain the soft and quantum computing techniques.

	computing techniques.	optimization, machine learning, and decision-making.				
General Objective 7.0 Understand Quantum Algorithms and Applications						
15	7.1 Explain the various quantum algorithms. 7.2 Explain the application of quantum algorithms in machine learning, and optimization.	Discuss quantum algorithms such as Quantum Support Vector Machine (QSVM), Quantum Generative Adversarial Network (QGAN), Quantum Approximate Optimization Algorithm (QAOA), Quantum K-Means Algorithm, and Quantum Neural Networks (QNN). Explain how the above-mentioned quantum algorithms can be used in other machine learning and optimization techniques such as such as regression, classification, and quantum-enhanced reinforcement learning.	MATLAB, Google Colab, Qiskit Aqua, Python libraries such as Quantum Neural Networks in Quantum Machine Learning (QML).	Implement Quantum and soft algorithms	Guide students to implement Quantum and soft algorithms	Explain the application of quantum algorithms in machine learning, and optimization.

AI Computing Solutions

Programme: Higher National Diploma Artificial Intelligence	Course Code: AIT 414	Contact Hours: 6Hours/week
Course Title: AI Computing Solutions	Credit Units: 4	Theoretical: 2 hour /week
Year: 2 Semester: 1	Pre-requisite:	Practical: 4 hour /week
Goal: This course is designed to provide students with the skills to develop and deploy AI applications			

General Objectives: On completion of this course the students should be able to:

1. Understand Basic Hardware Components of AI Processor

2. Understand the Various Software Architecture of AI Processor

3. Explore the different AI Computing Solutions

4. Apply AI Industrial Solutions

5. Explore Different AI Open Platforms

6. Explore Cloud Enterprise Intelligence Application Platforms

7. Understand the Concept of AI Applications Models Deployment

PROGRAMME: HIGHER NATIONAL DIPLOMA ARTIFICIAL INTELLIGENCE

COURSE: AI Computing Solutions		COURSE CODE: AIT 414		Contact Hours: 6 Hours/Week		
Credit Units: 4		Pre-requisite: Nil		Theoretical: 2 hours/week		
				Practical: 4 hours/week		
Goal: This course is designed to provide students with the skills to develop and deploy AI applications						
COURSE SPECIFICATION: Theoretical Contents:			Practical Contents:			
General Objective: 1.0 Understanding Basic Hardware Components of AI Processor						
WEEK	Specific Learning Outcomes	Teachers Activities	Learning Resources	Specific Learning Outcomes	Teachers Activities	Evaluation
1-3	1.1 Explain the basic concept of hardware acceleration and its importance in speeding up AI computations. 1.2 Explain acceleration techniques. 1.3 Explain how specialized hardware units can improve the efficiency of specific AI operations.	Explain the concept of hardware acceleration and its importance in speeding up AI computations. Discuss acceleration techniques, such as Ascent AI processor, tensor core units and systolic arrays that are used in AI processors. Explain how specialized hardware units can improve the efficiency of specific AI operations.	Visual representations of hardware accelerators such as; Huawei Ascend AI Processors, Google Tensor Processing Unit (TPU), Intel Nervana Neural Network Processor (NNP), NVIDIA Tensor Cores, Qualcomm Hexagon DSP	Compare performance of a CPU-based AI computation. Compare the performance of a systolic array.	Guide students to compare the performance of a CPU-based AI computation with a hardware-accelerated version using tensor cores. Demonstrate how to implement and evaluate the performance	Explain the concept of hardware acceleration and its importance in speeding up AI computations. Explain how specialized hardware units can improve the efficiency of specific AI operations.

						of a systolic array for matrix multiplication in an AI processor.	

General Objective 2.0: Understand the Various Software Architecture of AI Processor

| 4-5 | 2.1 Explain the basic Software Architecture of AI Processor

2.2 Explain the concept of Optimization Techniques in AI Processor.

2.3 Explain integration process for existing Systems.

2.2 Explain how to interface AI processors with existing APIs. | Discuss the various processor of AI software architecture.

Explain the role of each component in AI computations.

Discuss the concepts of vectorization and parallelization, and explain code optimization examples.

Provide visual aids and diagrams for better comprehension.
Explain the integration process of AI processors into existing systems. | Presentation software (e.g., PowerPoint).

Educational videos. Documents on AI processor optimization techniques. Visualization tools (e.g., diagrams, graphs)
 - API documentation and | Identify components of software architecture in AI processors.

Identify different optimization techniques.

Identify AI integration processor. | Guide students to identify the components of software architecture in AI processors.

Guide students to implement and compare different optimization techniques for AI workloads using appropriate.

Guide students to | Explain the integration process of AI processors into existing systems.

Explain how to interface AI processors with existing APIs.

Discuss communication protocols and data exchange. |

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	2.3 Discuss communication protocols and data exchange.	Explain how to interface AI processors with existing APIs. Discuss communication protocols and data exchange.			integrate AI processors into a larger system or software architecture, considering compatibility and communication requirements.	
General Objective 3.0: Explore the different AI Computing Solutions						
6-7	3.1 Explain the different AI Computing Solutions. 3.2 Explain the application of AI Computing Solutions in various domains. 3.3 Explain the benefits of AI Computing Solutions in addressing complex problems. 3.4 Explain AI Computing Solutions Implementation.	Explain the concept and components of AI Computing Solutions. Discuss the application of AI Computing Solutions in various domains. Explain the benefits of AI Computing Solutions in addressing complex problems. Explain how to set up and configuring AI software stacks.	AI development platforms (e.g. Huawei HCIA, and TensorFlow). AI development platforms (e.g., TensorFlow, PyTorch, scikit-lear, and MindSpore).	Develop AI applications. Set up the AI stack software.	Guide students to develop AI applications for specific tasks using appropriate AI frameworks, such as Huawei MindSpore,	Explain AI model development and deployment. Explain evaluation metrics and methodologies for AI model assessment.

	3.5 Explain AI model development and deployment.	Explain AI model development and deployment.	AI evaluation libraries (e.g., scikit-learn)		Guide students to Set up AI software stack on machines or cloud platforms using MindSpore.	Discuss benchmarking and comparison with existing AI solutions.
	3.6. Explain how to evaluate AI Computing Solutions.	Explain evaluation metrics and methodologies for AI model assessment.	AI fairness and ethics assessment frameworks.			
		Discuss benchmarking and comparison with existing AI solutions.		Fine-Tune AI model	Guide students to Fine-tune an AI models to improve robustness and fairness.	
General Objectives: 4.0 Understand how to Implement AI Industrial Solutions						
8-10	4.1 Explain AI Industrial Applications	Explain the role of AI in various industrial domains.	AI application frameworks (e.g., Huawei MindSpore AI Development Framework, TensorFlow, scikit-learn). AI model development tools (e.g., Huawei	Identify the different potential of AI applications in industrial processes.	Guide students to identify the different potential of AI applications in industrial processes.	Explain how to select appropriate AI algorithms and models.
	4.2 Explain the impact of AI on process automation and optimization.	Explain the impact of AI on process automation and optimization.				Explain data preprocessing techniques for industrial data.

4.3 Explain the benefits of AI integration in manufacturing, logistics, predictive maintenance, and other industrial sectors. 4.4 Explain how to select appropriate AI algorithms and models. 4.5 Explain data preprocessing techniques for industrial data. 4.6 Explain the different techniques for optimizing AI models for industrial Processes. 4.7 Explain how to integrate AI Solutions into Industrial Processes.	Discuss the benefits of AI integration in manufacturing, logistics, predictive maintenance, and other industrial sectors. Explain how to select appropriate AI algorithms and models. Explain data preprocessing techniques for industrial data. Explain the different techniques for optimizing AI models for industrial tasks, such as transfer learning and fine-tuning. Explain how to integrate AI Solutions into Industrial Processes. Discuss challenges and considerations for AI implementation.	ModelArts, TensorFlow, PyTorch, Keras) Data preprocessing tools (e.g., Pandas, NumPy etc).Cloud platforms and APIs (e.g., AWS, Azure, Elastic Cloud Server (ECS), Object Storage Service (OBS) API, Virtual Private Cloud (VPC) API, Cloud DNS (Domain Name Service) API.	Develop a project proposal outlining AI integration in an industrial setting Implement AI models for specific industrial tasks using relevant datasets. Evaluate AI model performance on industrial datasets.	Guide students to develop a project proposal outlining AI integration in an industrial setting. Guide students to implement AI models for specific industrial tasks using relevant datasets. Guide students to evaluate AI model performance on industrial datasets.	Explain the different techniques for optimizing AI models for industrial tasks, such as transfer learning and fine-tuning. Explain how to integrating AI Solutions into Industrial Processes

	4.2 Explain AI Models for Industrial applications. 4.3 Explain AI Solution integration processes.			Fine-tune AI models to improve efficiency in specific scenarios.	Guide students to Fine-tune AI models to improve efficiency in specific scenarios.	
General Objective 5.0: Explore Different AI Open Platform						
11-12	5.1 Explain the concepts of AI platforms. 5.2 Explain AI applications and use cases to illustrate the potential of AI technologies 5.3 Explain how to use AI platform APIs and SDKs for application development. 5.4 Explain how to integrate AI services into applications	Discuss the basic concepts of AI such as machine learning, deep learning, and natural language processing. Discuss AI applications and use cases to illustrate the potential of AI technologies. Discuss how to use AI platform APIs and SDKs for application development. Explain how to integrate AI services into applications.	TensorFlow Playground or PyTorch, and Model Arts: Huawei Elastic Cloud Server (ECS), Google Cloud Vision API, Microsoft Azure AI Fairness 360 (AIF360) toolkit, Fairness Indicators from TensorFlow for fairness evaluation, and Internal Bias Mitigation Research and Tools.	Design a simple AI application or chatbot especially in groups Train AI model using accessible datasets and AI development frameworks Develop a computer vision application	Guide students to design a simple AI application or chatbot especially in groups. Guide students to train AI model using accessible datasets and AI development frameworks Guide students to develop a	Discuss how to use AI platform APIs and SDKs for application development. Explain how to integrate AI services into applications. Discuss the various ethical considerations regarding AI technologies deployment.

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	5.5 Explain AI Applications development process. 5.5 Explain case studies of AI bias and fairness issues to raise awareness 5.6 Explain AI deployment and ethics.	Discuss the various ethical considerations regarding AI technologies deployment. Discuss case studies of AI bias and fairness issues to raise awareness. Explain the techniques for mitigating bias and ensuring fairness in AI models.		using image recognition APIs. Create a sentiment analysis tool using natural language processing APIs Analyze AI models for bias using fairness evaluation libraries.	computer vision application using image recognition APIs. Guide students to create a sentiment analysis tool using natural language processing APIs. Guide students to analyse AI models for bias using fairness evaluation libraries. Guide students to implement algorithms	

						for bias correction and fairness enhancement	

General Objective 6.0: Explore Cloud Enterprise Intelligence (EI) Application Platform

13-14	6.1 Explain cloud EI service. 6.2 Explain deep learning models' application to real-world problems. 6.3 Explain computer vision, natural language processing, and generative modeling	Explain cloud EI service. Explain deep learning models' application to real-world problems. Explain computer vision, natural language processing, and generative modeling.	MindSpore by Huawei, PyTorch, TensorFlow by Google , and MXNet By Apache Software Foundation (ASF).	Carry out practical on AI-enabled edge computing platforms	Guide students to use different AI-enabled edge computing platforms such as; Huawei HiLens Platform, Google Cloud IoT Edge, AWS IoT Greengrass, and Microsoft Azure IoT Edge	Explain cloud EI service. Explain deep learning models' application to real-world problems. Explain computer vision, natural language processing, and generative modeling

General Objective 7.0: Understand the Concept of AI Applications Models Deployment

15	7.1 Explain the necessary tools needed for AI model deployment.	Discuss AI models development process, such as; - Data preparation. -Model training.	ModelArts, TensorFlow Playground or PyTorch.				

		- Model deployment. - Application development.				

AI Project Management

PROGRAMME: HIGHER NATIONAL DIPLOMA ARTIFICIAL INTELLIGENCE		
COURSE TITLE: AI Project Management	**Course Code: AIT 415**	**Contact Hours:** 4Hours/week
CREDIT UNIT: 2	**PRE-REQUISITE:**	**Theoretical:** 2 hours /week
YEAR: TWO	**SEMESTER: ONE**	**Practical:** 2 hours /week
GOAL: This course is designed to provide students with the skills to manage Artificial Intelligence projects		
General Objectives: On completion of the course, the student should be able to: 1.0 Understand the fundamentals of project management and its application to AI projects. 2.0 Appreciate the unique challenges and requirements of managing AI projects. 3.0 Apply traditional and agile methodologies to AI projects. 4.0 Develop a project plan. 5.0 Understand how to apply best practices for team management in AI projects. 6.0 Use project management tools relevant to AI projects. 7.0 Understand the ethical considerations, privacy issues, and legal implications inherent in AI project management.		

PROGRAMME: HIGHER NATIONAL DIPLOMA ARTIFICIAL INTELLIGENCE						
COURSE: AI Project Management			**COURSE CODE: AIT 415**		**Contact Hours:** 4 Hours/Week	
Credit Units: 2			**Pre-requisite: Nil**		**Theoretical**: 2 hours/week	
					Practical: 2 hours/week	
GOAL: This course is designed to equip students with the knowledge and skills necessary to manage Artificial Intelligence projects.						
COURSE SPECIFICATION: Theoretical Contents:				**Practical Contents:**		
	General Objective: 1.0 Understand the fundamentals of project management and its application to AI projects					
WEEK	**Specific Learning Outcomes**	**Teachers Activities**	**Learning Resources**	**Specific Learning Outcomes**	**Teachers Activities**	**Evaluation**
1-3	1.1 Explain the principles of project management including project initiation, planning, execution, control, and closure.	Explain the fundamentals of project management, focusing on its application in AI.	Learning Management System for content delivery. Access to case studies related to AI project management. Access to project management software or tools.			Explain the principles of project management including project initiation, planning, execution, control, and closure.
	1.2 Explain key differences between managing AI projects and other types of projects.	Explain key differences between managing AI projects and other types of projects.				

	1.3 Explain the specific challenges of managing AI projects.	Discuss the specific challenges of managing AI projects like data gathering, data cleaning, model selection, training and testing, deployment, and maintenance the specific challenges of managing AI projects.				

General Objective 2.0 Appreciate the unique challenges and requirements of managing AI projects.

4-5	2.1 Explain the unique challenges involved in AI projects 2.2 Explain strategies to mitigate these challenges, such as effective data management, selection of appropriate AI	Explain the unique challenges involved in AI projects such as data acquisition, data privacy, model selection, model interpretability, and deployment issues. Explain strategies to mitigate these challenges, such as effective data management, selection of appropriate AI	Moodle, Blackboard, Microsoft Power BI Microsoft Office 365 Teams, Google Doc, Teamviewer	Use LMS for content delivery such as Moodle, Blackboard, MS Power BI. Use Collaboration tools for brainstorming and group discussions	Guide students to use LMS for content delivery such as Moodle, Blackboard, MS Power BI Guide students to use Collaboration tools for brainstorming and group discussions	Explain the unique challenges involved in AI projects such as data acquisition, data privacy, model selection, model interpretability, and deployment issues

	models, and a robust testing and deployment process.	models, and a robust testing and deployment process.				
	2.3 Explain the importance of cross-functional collaboration in AI projects.	Explain the importance of cross-functional collaboration in AI projects, including coordination with data scientists, software engineers, business stakeholders, and others.				
General Objective 3.0: Apply traditional and agile methodologies to AI projects**.**						
6-7	3.1 Explain the principles and processes of traditional project management methodologies and their potential use in AI projects. 3.2 Explain the principles and	Explain the principles and processes of traditional project management methodologies and their potential use in AI projects. Explain the principles and processes of agile	Moodle, Blackboard, Microsoft Power BI MS Project Primavera	Apply Moodle, Blackboard, Microsoft Power BI MS Project to manage AI Project	Guide students to apply Moodle, Blackboard, Microsoft Power BI MS Project to manage AI Project	Explain both traditional and agile project management methodologies to hypothetical AI projects, determining which approach (or combination thereof) is most

	processes of agile project management methodologies and how their iterative approach can accommodate the uncertainties and evolving nature of AI projects.	project management methodologies and how their iterative approach can accommodate the uncertainties and evolving nature of AI projects.	Microsoft Office 365 Teams, Google Doc, Teamviewer			suitable in different circumstances.
	3.3 Describe both traditional and agile project management methodologies to hypothetical AI projects, determining which approach (or combination thereof) is most suitable in different circumstances.	Explain both traditional and agile project management methodologies to hypothetical AI projects, determining which approach (or combination thereof) is most suitable in different circumstances.				

General Objectives: 4.0 Develop a project plan.						
9-10	4.1 Explain the scope of an AI project, including how to set realistic goals and objectives. 4.2 Explain how to develop a feasible timeline for an AI project, accounting for various stages of the AI development process. 4.3 Explain resource planning and allocation for an AI project, recognizing the unique resource needs of AI projects.	Explain various components of a comprehensive project plan for an AI project. Explain how to develop a feasible timeline for an AI project, accounting for various stages of the AI development process. Explain resource planning and allocation for an AI project, recognizing the unique resource needs of AI projects.	MS Project, Primavera	Use Project management tools to plan and allocate resources for AI projects Use Project management tools to develop timeline for AI projects Use Project management tools to analyse and mitigate risks in AI projects	Guide students to use Project management tools to plan and allocate resources for AI projects Guide students to use Project management tools to develop timeline for AI projects Guide students to use Project management tools to analyse and mitigate risks in AI projects	Explain risk management within the context of AI projects, including identifying, analyzing, and mitigating potential risks.

	4.4 Explain risk management within the context of AI projects, including identifying, analyzing, and mitigating potential risks.	Explain risk management within the context of AI projects, including identifying, analyzing, and mitigating potential risks.				
General Objective: 5.0 Understand how to apply best practices for team management in AI projects.						
11-12	5.1 Explain the dynamics and unique challenges of managing cross-functional teams in AI projects. 5.2 Explain strategies for effective communication and collaboration within a cross-functional AI team. 5.3 Explain the nuances of managing remote	Explain the best practices of team management, particularly in the context of AI projects. Explain strategies for effective communication and collaboration within a cross-functional AI team. Explain the nuances of managing remote teams, particularly	Microsoft Office 365 Teams Google Doc, Teamviewer MS Project Primavera Access to case studies literature, and industry reports on team management in AI projects. Project management software and collaboration tools that students can use to practice managing virtual teams.	Use project management tools for collaboration in AI project	Guide students to use project management tools for collaboration in AI project	Explain the nuances of managing remote teams, particularly in the context of AI projects.

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	teams, particularly in the context of AI projects. 5.4 Explain Leverage project management tools and technology for effective team management in AI projects.	in the context of AI projects. Explain project management tools and technology for effective team management in AI projects.				
General Objective 6.0: Use project management tools relevant to AI projects						
13-14	6.1 Explain of project management tools, software and their application in managing AI projects. 6.2 Explain various project management tools, such as Jira, Trello, and Asana, among others.	Explain of project management tools, software and their application in managing AI projects. Explain various project management tools through demonstrations or tutorials.	MS Project Primavera Computer lab or personal computers with internet access. Subscription or access to various project management tools (e.g., Jira, Trello, Asana). Training materials or guides for using these tools.	Simulate AI project using these tools for project management.	Guide Students to simulate AI project using these tools for project management.	Explain the appropriate tools based on the unique requirements of different AI projects.

	6.3 Explain the appropriate tools based on the unique requirements of different AI projects. 6.4 Explain the role of these tools in team collaboration, project tracking, resource management, and risk management in AI projects.	Explain the appropriate tools based on the unique requirements of different AI projects. Explain the role of these tools in team collaboration, project tracking, resource management, and risk management in AI projects.				
General Objective 7.0 Understand the ethical considerations, privacy issues, and legal implications inherent in AI project management						
15	7.1 Explain the ethical considerations in managing AI projects. 7.2 Describe privacy issues in AI projects, especially related to data management.	Discuss the ethical, privacy, and legal issues in AI project management. Explain how these issues can arise in real-world AI projects and how they can be managed.	Classroom or virtual learning platform for lectures and discussions. Access to research papers, articles, and case studies related to ethical, privacy, and legal issues in AI.			Describe privacy issues in AI projects, especially related to data management.

	7.3 Explain the legal implications of AI projects.	Explain the legal implications of AI projects, such as intellectual property rights, compliance with data protection laws, and other regulations.			
	7.4 Explain the potential impacts of ignoring these considerations and issues	Explain the potential impacts of ignoring these considerations and issues			

YEAR TWO SEMESTER TWO COURSES

Networks Security for AI

Programme: Higher National Diploma Artificial Intelligence	Course Code: 421	Contact Hours: 4 hours /week
Course Title: Networks Security for AI	Credit Unit: 2	Theoretical: 2 hours /week
Year: 2 Semester: 2	Pre-requisite: AIT 313	Practical: 2 hours /week
Goal: This course is designed to provide students with knowledge and skills in networks security for AI.		
General Objectives: On completion of this course the student should be able to: 1.0 Understand AI Security Concept 2.0 Understand Network Architecture for AI 3.0 Comprehend AI Model Deployment Security 4.0 Comprehend Network Security for AI Systems 5.0 Understand AI and Internet of Things (IoT) Security Integration 6.0 Comprehend AI Privacy and Regulatory Compliance 7.0 Understand threats to AI data sent on the network		

PROGRAMME: HIGHER NATIONAL DIPLOMA ARTIFICIAL INTELLIGENCE

Course: Security and Networks for AI	COURSE CODE: AIT 421	Contact Hours: 4 hours /week
Credit Units: 2	**Pre-requisite:** Nil	**Theoretical:** 2 hours /week
		Practical: 2 hours /week

Goal: This course is designed to provide students with knowledge and skills in networks security for AI.

COURSE SPECIFICATION: Theoretical Contents: Practical Contents:

General Objective: 1.0 Understand AI Security Concept

WEEK	Specific Learning Outcomes	Teachers Activities	Learning Resources	Specific Learning Outcomes	Teachers Activities	Evaluation
1-3	1.1 Explain AI security concept. 1.2 Explain AI systems security including Data privacy, and security models. 1.3 Explain adversarial attacks on AI Data.	Discuss the concept of AI security. Discuss the different AI data privacy issues and security models. Discuss the different AI systems security issues. Explain adversarial attacks on AI Data.	OWASP (Open Web Application Security Project) for securing AI systems. NIST Cybersecurity Framework and ISO/IEC 27001 for securing AI applications and networks.	Apply Open Web Application Security Project to assess AI systems Simulate AI Network.	Guide students to assess and improve the security of AI applications and model deployment. Guide students to use network simulation tools to experiment with different network architectures	Discuss the different AI data privacy issues and security models

						and security configurations.	
General Objectives: 2.0 Understand Network Architecture for AI							
4	2.1 Explain the concept of network architecture and infrastructure. 2.2 Explain the necessary network infrastructure that support AI applications 2.3 Explain distributed computing, edge computing, and cloud networking.	Discuss the various AI network architecture and infrastructure. Discuss the necessary architectures and infrastructures required for AI applications deployment such as distributed computing, edge computing, and cloud networking.	White board. TensorFlow Privacy, PySyft, Adversarial Robustness Toolbox (ART)			Discuss research papers on AI security and network topics
General Objective 3.0: Comprehend AI Model Deployment Security							
5-6	3.1 Explain the different techniques and practices of securing AI models. 3.2 Explain how to protect deployed AI models in production environments.	Discuss data privacy measures to protect sensitive information used for training AI. Discuss homomorphic encryption to allow computations on encrypted data without decrypting it to ensuring data privacy.	White board. TensorFlow Privacy, PySyft, Adversarial Robustness Toolbox (ART)	Use Python Libraries, or Google Colab to show students how to secure AI models.	Guide students to use Python Libraries, or Google Colab to show students how to secure AI models.	Explain how to use model deployment mechanisms to ensure that AI models are hosted on trusted servers and accessed through secure channels.

	3.3 Explain how to maintain the confidentiality and integrity of AI models and data.	Explain how to use model deployment mechanisms to ensure that AI models are hosted on trusted servers and accessed through secure channels.				
General Objective 4.0: Comprehend Network Security for AI Systems						
7-8	4.1 Explain network security principles for AI systems. 4.2 Explain secure communication protocols, and access controls. 4.3 Explain intrusion detection in AI applications.	Discuss the principles for AI systems such as; Model Integrity and Authenticity, Secure APIs and Communication, Secure Data Storage and Transmission. Discuss Access Control and Authorization, and intrusion detection in AI application	White board. TensorFlow Privacy, PySyft, Adversarial Robustness Toolbox (ART)	Perform Regular Security Audits and Monitoring. Carry out Threat Modeling and Risk Assessment	Guide students on how to secure and monitor AI applications and data	Explain intrusion detection in AI applications.
General Objective: 5.0 Understand AI and Internet of Things (IoT) Security Integration						
9-10	5.1 Explain the concept of Internet of Thing (IoT). 5.2 Explain how AI and Internet of Things (IoT) technologies intersect.	Discuss the concept of IoT. Discuss the intersection between AI and IoT, and different AI-IoT technologies such as;	White board. TensorFlow Privacy, PySyft, Adversarial Robustness Toolbox (ART)	Use IoT Device Security.	Guide students to analyze the security vulnerabilities of different IoT devices, such as smart	Explain the various challenges associated with the above mention AI-IoT technologies.

		Smart cities, smart homes, predictive maintenance, and Healthcare IoT with AI analytics. etc.				home devices, wearables, or industrial sensors.	
	5.3 Explain the security challenges associated with AI-powered IoT devices.	Explain the various challenges associated with the above mention AI-IoT technologies.		Simulate Adversarial Attack		Guide students to launch adversarial attacks on AI models integrated with IoT systems. Guide Students to experiment with techniques like adversarial inputs to understand AI model vulnerabilities	
General Objective 6.0: Comprehend AI Privacy and Regulatory Compliance
11-12	6.1 Explain the concept of data privacy, regulations, and legal considerations. 6.2 Explain AI data privacy and	Discuss the concepts of AI privacy, data protection laws, and regulatory compliance, such as GDPR (General Data Protection	White board. PC with internet connection.				Explain the different methods used to ensure compliance,

	regulations for AI application. 6.3 Explain the different methods used to ensure compliance and protect AI user privacy.	Regulation) and CCPA (California Consumer Privacy Act)	GDPR Guidelines, CCPA Resources, and AI Ethics Guidelines.			and protect AI user privacy.
General Objective 7.0: Understand the threats to AI data sent on the network						
13-15	7.1 Explain AI Data Vulnerabilities.	Discuss the various vulnerabilities and threats that AI data faces when transmitted over networks, including interception, eavesdropping, data tampering, and unauthorized access.	Encryption Libraries and Tools such as; OpenSSL and GnuPG	Encrypt and decrypt AI data using different encryption techniques	Guide students to encrypt and decrypt AI data using different encryption techniques, emphasizing the importance of encryption for data protection	Explain the various vulnerabilities and threats that AI data faces when transmitted over networks, including interception, eavesdropping, data tampering, and unauthorized access.
	7.2 Explain Network Security Protocols.	Discuss the different network security protocols, such as HTTPS, SSL/TLS, and VPN, and their role in protecting AI data during transmission.				
	7.3 Describe encryption Techniques for AI Data.	Discuss encryption techniques, such as symmetric and asymmetric encryption works, and how they can				

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	7.4 Explain Threat Mitigation Strategies	be applied to secure AI data sent over networks. Discuss proposed appropriate threat mitigation strategies, such as using secure communication channels, implementing access controls, and performing regular security audits.				

PROGRAMME: HIGHER NATIONAL DIPLOMA ARTIFICIAL INTELLIGENCE			
COURSE: Robotics and Intelligent System	**CODE:** 422	**Credit Unit:** 3	**Contact Hours:** 4Hours/week
GOAL: This course is designed to provide students with knowledge and skills in robotics and intelligent systems			
YEAR: TWO SEMESTER**: TWO**	**PRE-REQUISITE: Nil**		**Theoretical:** 2 Hours/week **Practical:** 2 Hours/week

GENERAL OBJECTIVES: On completion of this course, the students should be able to: 1.0 Understand the fundamental of robotics and intelligent systems.   2.0 Understand robotic components, sensors, actuators, effectors, and control mechanisms.   3.0 Design intelligent robotic systems for real-world applications.   4.0 Understand artificial intelligence and machine learning techniques in robotics for enhanced decision-making and autonomy.   5.0 Understand problem-solving skills by analyzing and optimizing robotic algorithms and behaviours.   6.0 Design projects and simulate robotic systems.   7.0 Comprehend ethical considerations and practices in the use of robotic systems.

PROGRAMME: HIGHER NATIONAL DIPLOMA ARTIFICIAL INTELLIGENCE

Course: Robotics and Intelligent System		Course Code: 422		Contact Hours: 4Hours/week	
Credit Unit: 3		Pre-requisite: NIL		Theoretical: 2 Hours/week Practical: 2 Hours/week	

GOAL: This course is designed to provide students with knowledge and skills in robotics and intelligent systems

Course Specification: **Theoretical Content:**			**Practical Content:**		

GENERAL OBJECTIVE 1.0: Understand the fundamental of Robotics and intelligent systems.

Course Specification:		THEORETICAL CONTENT	PRACTICAL CONTENT		
Week	Specific Learning Outcome	Teachers' Activities	Learning Resources	Specific Learning Outcome	Teachers' Activities	Evaluation
1-2	3.1 Explain the fundamentals of robotics and intelligent systems 3.2 Explain the key components of robotic systems 3.3 Explain the applications of robotics and intelligent systems 3.4 Explain the principles of robotic control systems 3.5 Explain the integration of AI and machine learning in robotics	Discuss robotics principles and technologies. Discuss on robotic components and technologies. Discuss applications of robotics and intelligent systems Discuss principles of robotic control and motion planning Discuss AI and machine learning in robotics	Marker board, Markers, Documentary films, Multimedia Projector and Screen, Case studies, Power point slides, Internet, Textbooks, Computer, Flip charts, research papers etc.	Design a Robotic System Architecture Build and Program Robotic Prototypes Implement Intelligent Algorithms in Robotics Simulating Robotic Behaviors	Guide student to design a Robotic System Architecture Guide student to build and program Robotic Prototypes Guide student to implement Intelligent Algorithms in Robotics Guide student to Simulate Robotic Behaviors	Explain the fundamentals of robotics and intelligent systems Explain the key components of robotic systems

				Develop Autonomous Robotic Systems	Guide student to Carry out an experiment on developing Autonomous Robotic Systems	
General Objective 2.0: Understand robotic components, sensors, actuators, effectors, and control mechanisms.						
3-4	2.1 List the types of robotics and the functions of its components	Enumerate the types of robotics and the functions of its components	Marker board, Markers, Documentary films, Multimedia Projector and Screen, Case studies, Power point slides, Internet, Textbooks, Computer, Flip charts, research papers etc.	Identify Robotic Components	Guide student to Identify Robotic Components	List the types of robotics and the functions of it components
	2.2. Explain the principles and operation of sensors in robotics	Discuss the principles and operation of sensors in robotics		Integrate Sensors in Robotic Systems	Guide student to Integrate Sensors in Robotic Systems	Discuss safety considerations in handling robotic components
	2.3. Explain the functions and types of robotic actuators	Discuss the functions and types of robotic actuators		Building and Controlling Robotic Actuators	Guide student to build and Control Robotic Actuators	
	2.4. Explain the principles of robotic control mechanisms	Explain the principles of robotic control mechanisms		Program and Tune Robotic Control Systems	Guide student to Carry out practical on Programming and Tuning Robotic Control Systems	
	2.5. Explain the applications of robotic components, sensors, and actuators	Discuss the applications of robotic components, sensors, and actuators		Design Robotic Systems with	Guide student to design Robotic Systems with	

	2.6. Explain safety considerations in handling robotic components	Explain safety considerations in handling robotic components		Components, Sensors, and Actuators	Components, Sensors, and Actuators	
GENERAL OBJECTIVE 3.0: Design intelligent robotic systems for real-world applications.						
5-6	3.1. Explain the principles of intelligent robotic systems	Discuss the principles of intelligent robotic systems	Marker board, Markers, Documentary films, Multimedia Projector and Screen, Case studies, Power point slides, Internet, Textbooks, Computer, Flip charts, research papers etc.	Design Intelligent Robotic System Architecture	Guide student to design Intelligent Robotic System Architecture	Explain the programming languages and frameworks for robotics
	3.2. Explain the programming languages and frameworks for robotics	Discuss the programming languages and frameworks for robotics		Program Intelligent Robotic Systems	Guide student to program Intelligent Robotic Systems	Explain real-world applications of intelligent robotic system
	3.3. Explain AI and machine learning techniques for robotics.	Explain AI and machine learning techniques for robotics.		Implement Machine Learning in Robotic Applications	Guide student to implement Machine Learning in Robotic Applications	
	3.4. Explain the concept of sensory perception in robotics	Discuss the concept of sensory perception in robotics				
	3.5. Explain real-world applications of intelligent robotic system	Discuss the real-world applications of intelligent robotic system		Implement Sensing and Perception in Robotic Systems	Guide student to implement Sensing and Perception in Robotic Systems	
					Guide student to build and Test	

	3.6. Explain the importance of ethical considerations in robotic systems	Explain the importance of ethical considerations in robotic systems		Build and Test Intelligent Robotic Prototypes Troubleshoot and Debug Intelligent Robotic Systems Integrate Ethical Principles in Robotic System Development	Intelligent Robotic Prototypes Guide student to Troubleshoot and Debug Intelligent Robotic Systems Guide student to. Integrate Ethical Principles in Robotic System Development	
GENERAL OBJECTIVE 4.0: Understand Artificial Intelligence and Machine Learning techniques in robotics for enhanced decision-making and autonomy.						
7-9	4.1. Explain the principles of Artificial Intelligence (AI) in robotics 4.2. Explain machine learning techniques for robotic applications 4.3. Explain AI-based decision-making in robotic systems	Discuss the principles of artificial intelligence (AI) in robotics Discuss machine learning techniques for robotic applications Explain AI-based decision-making in robotic systems	Marker board, Markers, Documentary films, Multimedia Projector and Screen, Case studies, Power point slides, Internet, Textbooks, Computer, Flip charts, research papers etc.	Implement AI Algorithms in Robotic Systems Develop Autonomous Robotic Systems with ML Integrate Reinforcement	Guide student to implement AI Algorithms in Robotic Systems Guide student to develop Autonomous Robotic Systems with ML Guide student to Integrate Reinforcement	Explain the principles of artificial intelligence (AI) in robotics Explain machine learning techniques for robotic applications

			Learning in Robotic Control	Learning in Robotic Control	Describe the concept of robot autonomy and its significance
4.4. Explain the concept of robot autonomy and its significance 4.5. Explain AI-driven path planning and navigation in robotics 4.6. Explain the importance of safety and robustness in AI-driven robotics	Explain the concept of robot autonomy and its significance Explain AI-driven path planning and navigation in robotics Explain the importance of safety and robustness in AI-driven robotics		Simulate Autonomous Robotic Behaviors	Guide student to Simulate Autonomous Robotic Behaviors	Explain the importance of safety and robustness in AI-driven robotics
			Implement AI Navigation in Mobile Robots	Guide student to Implement AI Navigation in Mobile Robots	
			Troubleshoot AI and ML Integration in Robotic Systems	Guide student to Troubleshoot AI and ML Integration in Robotic Systems	
			Implement Safety Measures in AI-Enabled Robotic Systems	Implement Safety Measures in AI-Enabled Robotic Systems	

General Objective 5.0: Understand problem-solving skills by analyzing and optimizing robotic algorithms and behaviours.

10-11	5.1 Explain the principles of robotic algorithms	Discuss the principles of robotic algorithms	Marker board, Markers, Documentary films, Multimedia Projector and Screen, Case studies, Power point slides, Internet, Textbooks, Computer, Flip charts, research papers etc.	Analyze and Optimize Robotic Algorithms	Guide student in Analyzing and Optimizing Robotic Algorithms	Explain the principles of robotic algorithms
	5.2 Explain optimization techniques for robotic systems	Discuss optimization techniques for robotic systems		Implement Optimization in Robotic Behaviors	Guide student in Implementing Optimization in Robotic Behaviors	Explain optimization techniques for robotic systems Describe the efficiency and effectiveness of robotic algorithms
	5.3 Explain the efficiency and effectiveness of robotic algorithms	Explain the efficiency and effectiveness of robotic algorithms				
	5.4 Explain the challenges and complexities of robotic behaviors	Discuss the challenges and complexities of robotic behaviors		Improve Robotic Path Planning and Navigation	Guide student in Improving Robotic Path Planning and Navigation	
	5.5 Explain machine learning techniques for behavior optimization	Explain machine learning techniques for behavior optimization		Debug and Enhance Robotic Behaviors	Guide student to Debug and Enhance Robotic Behaviors	
	5.6 Explain the importance of iterative refinement in robotics	Discuss the importance of iterative refinement in robotics		Implement Reinforcement Learning in Behavior Optimization	Guide student in Implementing Reinforcement Learning in Behavior Optimization	

				Troubleshoot Algorithmic Issues in Robotic Systems	Guide students In Troubleshooting Algorithmic Issues in Robotic Systems	

General Objective 6.0: Design projects and simulate robotic systems.

Week						
12-14	6.1 Explain the importance of hands-on experience in robotics	Explain the importance of hands-on experience in robotics	Marker board, Markers, Documentary films, Multimedia Projector and Screen, Case studies, Power point slides, Internet, Textbooks, Computer, Flip charts, research papers etc.	Build and Assemble Robotic Systems	Guide student in Building and Assembling Robotic Systems	List the various robotic system components and functions
	6.2 List the various robotic system components and functions	List the various robotic system components and functions		Simulate Robotic Behaviors	Guide student in Simulating Robotic Behaviors	
	6.3 Explain how to interpret simulation results for robotic systems	Explain how to interpret simulation results for robotic systems		Integrate Sensors and Actuators in Practical Projects	Guide students in Integrating Sensors and Actuators in Practical Projects	Explain how to interpret simulation results for robotic systems
	6.4 Explain the process of experimental design in robotics	Discuss the process of experimental design in robotics		Collaborate in Project Development	Guide student to in Collaborative Project Development	
	6.5 Enumerate different sensors and actuators in practical projects	Enumerate different sensors and actuators in practical projects		Document and Reflect on Practical Projects	Guide student in Documentation	

	6.6 Explain documentation and reflection in practical projects	Discuss documentation and reflection in practical projects			and Reflection on Practical Projects	

GENERAL OBJECTIVE: 7.0. Comprehend ethical considerations and practices in the use of robotic systems.

15	7.1 Explain the ethical implications in robotic system design 7.2. Explain responsible practices for deploying robotic systems 7.3. Explain potential ethical challenges in the use of robotic systems 7.4. Explain the importance of transparency in robotic decision-making 7.5. Explain fairness and accountability in robotic systems 7.6. Explain continuous learning and adaptation of ethical practices	Explain 7.1 to 7.6 with detailed note.		Carry out Ethical Analysis of Robotic System Designs Develop Responsible Deployment Strategies Address Ethical Challenges in Robotic System Implement Transparent Decision-Making in Robotic Systems	Guide student to Carry out Ethical Analysis of Robotic System Designs Guide student in Developing Responsible Deployment Strategies Guide student in Addressing Ethical Challenges in Robotic System Guide student to Implement Transparent Decision-Making in Robotic Systems	Explain the ethical implications in robotic system design Explain potential ethical challenges in the use of robotic systems Explain the importance of transparency in robotic decision-making

				Evaluate Fairness and Accountability in Robotic Systems	Guide student to Evaluate Fairness and Accountability in Robotic Systems	
				Carry out Ethical Dilemma Role-Playing and Analysis	Guide student to Carry out Ethical Dilemma Role-Playing and Analysis	
				Carry out Reflective Ethical Practice in Robotic System Development	Guide student to Carry out Reflective Ethical Practice in Robotic System Development	

ASSESSMENT: The continuous assessment; tests and quizzes will be awarded 40% of the total score. The end of the Semester Examination will make up for the remaining 60% of the total score.

Web and Mobile Application Development

PROGRAMME: HIGHER NATIONAL DIPLOMA ARTIFICIAL INTELLIGENCE		
COURSE TITLE: Web and Mobile Application Development	**Course Code: AIT 423**	**Contact Hours: 4** Hours/week
CREDIT UNIT: 2	**PRE-REQUISITE:**	**Theoretical:** 2 Hours/week
YEAR: TWO	**SEMESTER: TWO**	**Practical:** 2 Hours/week
GOAL: This course is designed to provide the student with the knowledge and skills required to develop and deploy web and mobile applications		
General Objectives: On completion of the course, the student should be able to: 1.0 Understand Web Technologies such as HTML, CSS, and JavaScript 2.0 Understand Mobile Application Development for both Android and iOS platforms using relevant Frameworks 3.0 Understand Backend Development in Server-side Programming Languages 4.0 Understand User Experience (UX) Design 5.0 Understand Responsive Design Techniques. 6.0 Understand Version Control Systems. 7.0 Understand Project Management and Deployment of Web and Mobile Applications		

PROGRAMME: HIGHER NATIONAL DIPLOMA ARTIFICIAL INTELLIGENCE					
Course: Web and Mobile Application Development		**COURSE CODE: AIT 423**		**Contact Hours: 4** Hours/week	
CREDIT UNIT: 2		**PRE-REQUISITE: Nil**		**Practical:** 2 Hours/week	
				Theoretical: 2 Hours/week	
GOAL: This course is designed to provide the student with the skills required to develop and deploy web and mobile applications.					
COURSE SPECIFICATION: Theoretical Contents:			**Practical Contents:**		
	General Objective: 1.0 Understand Web Technologies such as HTML, CSS, and JavaScript.				
WEEK	**Specific Learning Outcomes**	**Teachers Activities**	**Learning Resources**	**Specific Learning Outcomes**	**Teachers Activities**	**Evaluation**
1-3	1.1 Explain how to develop structured and semantically correct web pages using HTML.

1.2 Explain how to create different types of web pages (e.g., basic static page, forms, tables) to practice HTML coding.

1.3 Explain how to create multi-page websites with proper page structure and semantic HTML. | Discuss how to develop structured and semantically correct web pages using HTML

Explain HTML syntax and elements.

Explain how to create different types of web pages (e.g., basic static page, forms, tables) to practice HTML coding.

Explain create multi-page websites with proper page structure and semantic HTML. | Slide presentations, textbooks, and online resources for lectures. Access to case studies and research papers on data science and AI. Computer with data analysis software (e.g., Python with libraries like pandas, NumPy, scikit-learn) for demonstrating the data science process. Python with TensorFlow, Keras) | Develop structured and semantically correct web pages using HTML.

Design and style visually appealing web pages using CSS.

Implement interactive and dynamic behavior on web pages using JavaScript. | Guide student to develop structured and semantically correct web pages using HTML.

Guide student to Design and style visually appealing web pages using CSS.

Guide students to Implement interactive and dynamic behavior on web pages | Explain how to develop structured and semantically correct web pages using HTML.

Explain how to create different types of web pages (e.g., basic static page, forms, tables) to practice HTML coding. |

	1.4 Describe how to design and style visually appealing web pages using CSS.	Explain how to design and style visually appealing web pages using CSS properties, selectors, and styling techniques.			using JavaScript.	
	1.5 Explain how to Implement interactive and dynamic behavior on web pages using JavaScript.	Explain how to Implement interactive and dynamic behavior on web pages using JavaScript:				
	1.6 Explain the fundamentals of JavaScript, including variables, functions, and event handling.	Discuss the fundamentals of JavaScript, including variables, functions, and event handling.				
	1.7 Explain how to build dynamic components or web applications that respond to user actions.	Explain how to build dynamic components or web applications that respond to user actions.				
	General Objective 2.0: Understand Mobile Application Development for both Android and iOS platforms using relevant frameworks					
4	2.1 Explain how to develop mobile applications for	Explain how to develop mobile applications for	Node.js, Python, or Ruby on Rails	Develop mobile applications for Android using	Guide students to develop mobile	Explain how to develop mobile applications for

Week						
	Android using relevant frameworks like React Native. 2.2 Explain mobile applications for iOS using relevant frameworks like React Native or Flutter. 2.3 Explain mobile application architecture and design patterns for cross-platform development	Android using relevant frameworks like React Native. Discuss mobile applications for iOS using relevant frameworks like React Native or Flutter. Discuss mobile application architecture and design patterns for cross-platform development		relevant frameworks like React Native. Develop mobile applications for iOS using relevant frameworks like React Native or Flutter.	applications for Android using relevant frameworks like React Native. Guide student to develop mobile applications for iOS using relevant frameworks like React Native or Flutter.	Android using relevant frameworks like React Native. Discuss mobile applications for iOS using relevant frameworks like React Native or Flutter.
General Objective 3.0: Understand Backend Development in Server-side Programming Languages						
5-6	3.1 Explain proficiency in server-side programming languages. 3.2 Explain how to build and manage databases for web and mobile applications.	Discuss proficiency in server-side programming languages like Node.js, Python, or Ruby on Rails Explain how to build and manage databases for web and mobile applications:	Node.js, Python, or Ruby on Rails	Use server-side programming languages like Node.js, Python, or Ruby on Rails. Build and manage databases for web and mobile applications.	Guide student to use server-side programming using Node.js, Python, or Ruby on Rails. Guide student on how to build and manage databases for web and mobile applications.	Explain proficiency in server-side programming languages like Node.js, Python, or Ruby on Rails. Explain how to build and manage databases for web

3.3 Explain sessions for each programming language, covering core concepts, syntax, and common libraries/frameworks	Describe sessions for each programming language, covering core concepts, syntax, and common libraries/frameworks.		Develop RESTful APIs and implement server-side logic to handle client requests.	Guide students to develop RESTful APIs and implement server-side logic to handle client requests.	and mobile applications.
3.4 Explain the fundamentals of database design, including data modeling and schema creation.	Explain the fundamentals of database design, including data modeling and schema creation.		Design databases for specific application scenarios	Guide students to design databases for specific application scenarios	
3.5 Describe how to use database management systems	Describe how to use database management systems (e.g., MySQL, PostgreSQL, MongoDB) to interact with databases.		Create a functional backend for a web or mobile application, which includes developing RESTful APIs and server-side logic.	Guide students to create a functional backend for a web or mobile application, which includes developing RESTful APIs and server-side logic.	
3.6 Explain how to develop RESTful APIs and implement server-side logic to handle client requests.	Explain how to develop RESTful APIs and implement server-side logic to handle client requests:				

		Explain the concept of RESTful APIs the role of APIs in web and mobile application development.				
	3.7 Explain the process of designing API endpoints and handling HTTP requests (GET, POST, PUT, DELETE) using their preferred backend language	Explain the process of designing API endpoints and handling HTTP requests (GET, POST, PUT, DELETE) using their preferred backend language.				
General Objective 4.0: Understand User Experience (UX) Design						
7-8	4.1 Explain the principles of user-centered design and its importance in creating effective digital experiences.	Discuss the core principles of user-centered design, usability, and user experience. Highlight the impact of user-centered design on product success.	Computers equipped with machine learning software (like Python's scikit-learn, TensorFlow, PyTorch). Access to a variety of real-world business datasets for practicing machine learning. Access to resources on machine learning algorithms and techniques. Access to resources for effective data	Create wireframes and prototypes to visualize and communicate design concepts. Apply usability principles to evaluate and improve the user experience of web and mobile applications.	Guide students to create wireframes and prototypes to visualize and communicate design concepts. Guide students to apply usability principles to evaluate and improve the user experience	Explain the principles of user-centered design and its importance in creating effective digital experiences.
	4.2 Explain wireframes and prototypes to visualize and communicate design concepts.	Explain wireframes and prototypes to visualize and communicate design concepts.				

4.4 Explain the principles of user-centered design and its importance in creating effective digital experiences	Discuss the principles of user-centered design and its importance in creating effective digital experiences design concepts:	presentation and communication.

wireframing tools (e.g., Balsamiq, Sketch, Figma) and prototyping software (e.g., InVision, Adobe XD). | | of web and mobile applications. |
4.5 Explain how to Apply usability principles to evaluate and improve the user experience of web and mobile applications.	Discuss usability how to apply principles to evaluate and improve the user experience of web and mobile applications		Create wireframes and interactive prototypes for different screen sizes and devices.	Guide students to create wireframes and interactive prototypes for different screen sizes and devices.
4.6 Explain usability testing methodologies and techniques.	Explain usability testing methodologies and techniques.		Design wireframes and prototypes based on specific application scenarios.	Guide student to design wireframes and prototypes based on specific application scenarios.
4.9 Explain how to conduct usability tests and gather feedback from users.	Explain how to conduct usability tests and gather feedback from users.		Conduct usability testing on existing applications or prototypes and analyze the results.	Guide student to conduct usability testing on existing applications or prototypes and

					analyze the results.	
	General Objective 5.0: Understand Responsive Design techniques					
9-10	5.1 Explain the concept of responsive design and its importance in creating adaptive user interfaces. 5.2 Explain media queries and flexible layouts to create responsive web pages that adjust to different screen sizes. 5.3 Explain responsive design frameworks like Bootstrap to streamline the development of responsive web applications. 5.4 Explain responsive websites and applications to	Explain the concept of responsive design and its importance in creating adaptive user interfaces Explain media queries and flexible layouts to create responsive web pages that adjust to different screen sizes: Explain how to Implement responsive design frameworks like Bootstrap to streamline the development of responsive web applications: Explain responsive websites and applications to illustrate the concept in practice.	Access to relevant literature, industry reports, and databases for identifying business problems. Project management tools for planning and monitoring the project. Computers with necessary data science software installed for project implementation. Presentation tools and equipment for communicating the results.	Apply media queries and flexible layouts to create responsive web pages that adjust to different screen sizes. Implement responsive design frameworks like Bootstrap to streamline the development of responsive web applications.	Guide students to apply media queries and flexible layouts to create responsive web pages that adjust to different screen sizes. Guide student to implement responsive design frameworks like Bootstrap to streamline the development of responsive web applications.	Explain the concept of responsive design and its importance in creating adaptive user interfaces. Explain media queries and flexible layouts to create responsive web pages that adjust to different screen sizes.

	illustrate the concept in practice.			Use different CSS techniques, like fluid grids and flexible images, to create adaptive designs.	Guide students to experiment with different CSS techniques, like fluid grids and flexible images, to create adaptive designs.	
	5.5 Explain the challenges and considerations of designing for multiple screen sizes and devices.	Discuss the challenges and considerations of designing for multiple screen sizes and devices.				
	5.6 Explain fundamentals of responsive design and its benefits.	Explain fundamentals of responsive design and its benefits.		Build web applications using responsive design frameworks	Guide students to build web applications using responsive design frameworks	
	5.7 Explain media queries in CSS to adapt layouts based on viewport size	Explain media queries in CSS to adapt layouts based on viewport size.				
	5.8 Explain how to apply media queries to an existing web page to make it responsive.	Explain how to apply media queries to an existing web page to make it responsive.				
	5.9 Describe how to use these frameworks to create responsive	Describe how to use these frameworks to create responsive				

	layouts and UI components.	layouts and UI components.			

General Objective 6.0: Understand Version Control Systems

| 11-13 | 6.1 Explain the fundamentals of version control and its significance in collaborative software development.

6.2 Explain control systems like Git for code management and collaboration.

6.3 Explain the benefits of version control in facilitating teamwork, code sharing, and codebase stability.

6.4 Explain how to manage code repositories, including creating branches, merging changes, and resolving conflicts. | Discuss the fundamentals of version control and its significance in collaborative software development

Explain proficiency in using version control systems like Git for code management and collaboration:

Discuss the benefits of version control in facilitating teamwork, code sharing, and codebase stability.

Explain version control concepts, including versioning, branching, and merging. | Access to relevant literature, industry reports, and databases for identifying business problems. Project management tools for planning and monitoring the project. Computers with necessary data science software installed for project implementation. Presentation tools and equipment for communicating the results. | Use version control systems like Git for code management and collaboration.

Manage code repositories, including creating branches, merging changes, and resolving conflicts.

Collaborate on codes with peers using Git, working on branches, and | Guide student to proficiently use version control systems like Git for code management and collaboration.

Guide student to effectively manage code repositories, including creating branches, merging changes, and resolving conflicts.

Guide student to collaborate on codes with peers using Git, working on | Explain the fundamentals of version control and its significance in collaborative software development.

Demonstrate proficiency in using version control systems like Git for code management and collaboration. Discuss the benefits of version control in facilitating teamwork, code sharing, and codebase stability. |

				resolving merge conflicts.	branches, and resolving merge conflicts.	
	6.5 Explain step-by-step tutorials on setting up and configuring Git repositories locally and remotely	Explain step-by-step tutorials on setting up and configuring Git repositories locally and remotely.		Create branches and merging code changes using different Git workflows.	Guide student to create branches and merging code changes using different Git workflows.	
	6.6 Explain common Git commands for staging, committing, and pushing code changes	Explain common Git commands for staging, committing, and pushing code changes		Carry out branching, merging, and conflict resolution on practice repositories.	Guide student to Carry out branching, merging, and conflict resolution on practice repositories.	
				Perform shared codebase using Git, employing branching and merging effectively.	Guide student to Carry out shared codebase using Git, employing branching and merging effectively.	

General Objective 7.0: Understand Project Management and Deployment of Web and Mobile Applications.					
14-15	7.1 Explain the principles of project management and its role in successful application development. 7.2 Explain software development projects, including defining objectives, tasks, and timelines. 7.3 Explain how to deploy web and mobile applications to production environments. 7.4 Explain project management methodologies 7.5 Explain how to plan and organize software development projects	Discuss the principles of project management and its role in successful application development Explain software development projects, including defining objectives, tasks, and timelines. Explain how to deploy web and mobile applications to production environments. Explain project management methodologies, such as Agile, Scrum, or Waterfall. Explain how to plan and organize software development projects, including defining	Access to relevant literature, industry reports, and databases for identifying business problems. Project management tools for planning and monitoring the project. Computers with necessary data science software installed for project implementation. Presentation tools and equipment for communicating the results.	Carry out software development projects. Deploy web and mobile applications to production environments. Manage real-world successful project Break down a project into manageable tasks and estimating effort.	Guide student to Carry out software development projects, including defining objectives, tasks, and timelines. Guide students to deploy web and mobile applications to production environments. Guide students to manage real-world successful project Guide student to break down a project into manageable tasks and	Explain software development projects, including defining objectives, tasks, and timelines.

	objectives, tasks, and timelines			estimating effort.
7.6 Explain the guidelines and templates for creating project plans, task lists, and Gantt charts. 7.7 Explain proficiency in deploying web and mobile applications to production environments 7.8 Explain the deployment process, including server setup, domain configuration, and database management	Discuss guidelines and templates for creating project plans, task lists, and Gantt charts. Discuss proficiency in deploying web and mobile applications to production environments: Explain the deployment process, including server setup, domain configuration, and database management.		Deploy applications to various hosting platforms (e.g., AWS, Heroku). Deploy completed web or mobile applications to live servers.	Guide student to deploy applications to various hosting platforms (e.g., AWS, Heroku). Guide student to deploy completed web or mobile applications to live servers.

List of Tools/Equipment for HND Artificial Intelligence (AI) Laboratory

Category	Tools and Equipment	Quantity
Powerful Computer	Laptop or Desktop Computer with following specification. ➢ Storage: 512 - SSD Minimum ➢ Processor: 3.5 GHz -to- 4.0 GHz ➢ RAM: 16GB -to- 32GB ➢ OS: 64 bits	40 (i.e., One for each student for maximum of 2 - Streams)
Internet Access	High speed Internet connectivity	30-50 mbps of Internet Access
Programming Languages	Python (with compilers or interpreters)	1 each
IDEs	Jupyter Notebook, PyCharm, Visual Studio Code, Anaconda, Google Colab	1 each
Machine Learning Frameworks	TensorFlow, PyTorch, Keras, scikit-learn, MindSpore, ModelArts,	1 each
Version Control	Git, GitHub, GitLab	1 each
Mathematics and Visualization	MATLAB, Simulink, Mathematica, NumPy, Matplotlib, Seaborn, Plotly, Pandas, MAPLE	1 each
Database Management Systems	MySQL, PostgreSQL, SQLite	1 each
Cloud Services	AWS, Google Cloud Platform (GCP), Microsoft Azure, Huawei Ascent AI Processor	1 each

Virtualization	Docker	1 each
Simulation Tools	Gazebo (robotics simulation), Unity (game development)	1 each
Text Editors	Sublime Text, Atom, Notepad++	1 each
Hardware (Optional)	GPUs, TPUs, such as; Huawei Ascend AI Processors, Intel Nervana Neural Network Processors, NVIDIA GPUs, Google Tensor Processing Unit.	1 each
Others	Office 365, Microsoft project	1 each
Online Learning Platforms	Coursera, edX, Udacity, UDEMY, Blackboard, Moodle, Edmodo	1 each
Books and Reference Material	Textbooks, research papers, online resources	Provide physical AI related books, research papers, and Subscribe to some Online Databases

NOTE: In addition to the above-mentioned tools/equipment's Artificial Intelligence Programme can equally share Electrical Electronics Lab for circuit and other practical's, and Mechatronic Lab for robotic practical's,

Necessary with following tools/equipment's.

No.	Equipment	Description	Purpose/Usage
1	Microcontroller Boards	Arduino, Raspberry Pi, ESP8266, ESP32	To create and program smart devices or robots
2	Sensors	Accelerometers, Gyroscopes, Proximity Sensors	Gather data from the environment for analysis
3	Motors and Actuators	DC Motors, Servo Motors, Stepper Motors	Enable robotic movement and interaction
4	Motor Drivers	H-bridges, Motor Shields	Control the speed and direction of motors
5	Prototyping Components	Breadboards, Jumper Wires, Resistors, LEDs	Build and test circuits for AI applications
6	Robotics Kits	DIY robot kits with various components	Provide a starting point for building robots
7	Cameras	USB Cameras, Raspberry Pi Camera Module	Capture visual data for computer vision tasks
8	LiDAR Sensors	Light Detection and Ranging for mapping	Create detailed maps and perform object detection
9	NVIDIA Jetson Platform	High-performance embedded AI computing platform	Accelerate AI computations in robotics projects
10	3D Printer	Creating custom robot parts and enclosures	Create custom components for robots and devices

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