GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Diploma Engineering
Level: Diploma
Branch: Biomedical Engineering
Subject Code: DI04003081
Subject Name: AI in Healthcare

w. e. f. Academic Year:	2025-26
Semester:	4th
Category of the Course:	Professional Elective - II

Prerequisite:	A foundational knowledge in science, mathematics and healthcare field.
Rationale:	Students pursuing a diploma in bio-medical engineering need to have a thorough understanding of the fundamental concepts and principles of artificial intelligence to cope with the current trend in healthcare. Diploma students undertaking this course are expected to apply the fundamentals of artificial intelligence to analyze the different healthcare challenges and also develop skills required to meet the expectations of the industry.

Course Outcome:

After Completion of the Course, Student will be able to:

No	Course Outcomes	RBT Level
1	Demonstrate fundamental understanding of the history of artificial intelligence and its types.	Remember
2	Demonstrate awareness and a fundamental understanding of AI techniques in artificial neural networks.	Understand
3	Understand the fundamental concepts of supervised learning.	Understand
4	Understand the fundamental concepts of unsupervised learning.	Understand
5	Apply basic principles of AI to solve healthcare problems.	Apply

**Revised Bloom's Taxonomy (RBT)*

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+(PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial / Practical		
L	T	PR	C	ESE(E)	PA(M)	PA(I)	ESE(V)	
2	0	4	4	70	30	20	30	150

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1	**Introduction to Artificial Intelligence**	05	
	1.1. Intelligence: Define, Types, Human and Machine Intelligence. 1.2. Artificial Intelligence (AI): Basic of AI, Strong AI, Weak AI, Reactive machines, Limited memory, Theory of mind, Self-awareness 1.3. History of Artificial Intelligence 1.4. Need for Artificial Intelligence 1.5. Relationship between Artificial Intelligence, Machine Learning and Deep Learning 1.6. Advantages, Disadvantages and Future of Artificial Intelligence 1.7. Applications of Artificial Intelligence		20%
2	**Fundamental of Artificial Neural Networks**	05	
	2.1 Basic of Artificial Neural Network (ANN) 2.2 History of ANN 2.3 Biological Neuron 2.4 Architecture of an artificial neural network 2.5 Types of Artificial Neural Networks: Feedback ANN, Feed-Forward ANN 2.6 Types of Learning: Supervised, Unsupervised and Reinforcement 2.7 Advantages of Artificial Neural Network 2.8 Disadvantages of Artificial Neural Network 2.9 Applications of Artificial Neural Networks		20%
3	**Supervised Learning Models**	8	
	3.1 Introduction of Supervised Learning: Define Regression, Classification, Clustering, Real-world Applications Examples. 3.2 Steps in Supervised learning. 3.3 Types of supervised learning algorithms: 3.3.1 Regression: Linear Regression, Regression Trees, Non-Linear Regression, Bayesian Linear Regression, Polynomial Regression. 3.3.2 Classification: Random Forest, Decision Trees, Logistic Regression, Support vector Machines, Naive Bayes, K-Nearest Neighbor. 3.4 Advantages of Supervised learning. 3.5 Disadvantages of Supervised learning.		20%

4	**Unsupervised Learning Models**	7	
	4.1 Introduction of Unsupervised Learning: Define and Working. 4.2 Types of Unsupervised learning algorithms: Clustering and Association. 4.3 K-means for clustering problems, Principal Component Analysis, Hierarchal clustering, Anomaly detection, Neural Networks. 4.4 Advantages of Unsupervised learning. 4.5 Disadvantages of Unsupervised learning. 4.6 Difference between Supervised and Unsupervised Learning.		20%
5	**Application of Artificial Intelligence in Healthcare and advance algorithms**	5	
	5.1 Fuzzy Logic Systems: Introduction, Architecture, Application, Advantages and Disadvantages. 5.2 Natural Language Processing (NLP): Introduction, Components and Steps. 5.3 Application of AI in Healthcare: Introduction, Traditional healthcare system, AI-based healthcare system for Disease Identification and Diagnosis, Application in Radiology, Dermatology, Drug interaction and manufacturing, Pre- and Post-diseases diagnosis, Predictive Analytics and Early Warning Systems, Remote Patient Monitoring 5.4 AI based biomedical waste management system.		20%
	Total	**30**	**100 %**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (in %)					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
30 %	**40 %**	**30 %**	--	--	--

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:

Sr. No.	Title of Book	Author	Publication with place, year and ISBN
1	Artificial Intelligence in Healthcare	Dr Parag Suresh Mahajan MD	MedMantra, LLC; Third edition or latest edition, ISBN-10: 1954612060, ISBN-13: 978-1954612068
2	AI-First Healthcare: AI Applications in the Business and Clinical Management of Health	Kerrie Holley	Shroff/O'Reilly; First Edition or latest edition, ISBN-10: 9391043194, ISBN-13: 978-9391043193
3	Artificial Intelligence Applications for Health Care	Mitul K. Ahirwal, Narendra D. Londhe, Anil Kumar	Taylor & Francis Ltd; 1st edition or latest edition, ISBN-10: 1032148462, ISBN-13: 978-1032148465
4	Comprehensive and Current Role of Artificial Intelligence in Medical Health Care Field	Ramakanth Bhargav P, Sabaretnam M	Mark-Fly, ISBN-10: 8195588093, ISBN-13: 978-8195588091
5	Artificial Intelligence	Elaine Rich and Kevin Knight	Tata Mcgraw Hill(2nd Edition)
6	Introduction to Artificial Intelligence and Expert Systems	Petterson, D.W.,	Prentice Hall of India (2007)

(b) Open-source software and website:

1. https://nptel.ac.in/
2. https://swayam.gov.in/
3. https://cse22-iiith.vlabs.ac.in/
4. https://www.investopedia.com/terms/a/artificial-intelligence-ai.asp
5. https://en.wikipedia.org/wiki/Artificial_intelligence
6. https://research.ibm.com/projects/virtual-experiments-a-lab-in-the-cloud
7. https://github.com/PacktPublishing/Artificial-Intelligence-with-Python
8. https://github.com/PacktPublishing/Python-Real-World-Machine-Learning
9. https://nptel.ac.in/courses/106106139

Suggested Course Practical List: If any

Sr. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
1	Explore any one platform (like python/colab) for AI with its libraries.	#*	4
2	Study about artificial intelligence.	1	2
3	Study about artificial neural network and biological neural network.	2	2
4	Write programs for Vectors, Matrices, and Arrays to perform various operations	3	4
5	Write programs to Load data sets	3	2
6	Write programs to perform manipulations on data	3	4
7	Write a Python program to implement a Simple Neural Network.	2	4
8	Write a Python program to implement a Linear Regression.	3	4
9	Write a Python program to implement a Logistic Regression.	3	4
10	Write a Python program to implement a Decision Trees.	3	4
11	Write a Python program to implement K-Nearest Neighbour algorithm for given dataset.	3	4
12	Write a Python program to implement Naive Bayes.	3	4
13	Write a Python program to implement Random Forest.	3	4
14	Write a Python program to implement Support vector Machines	3	4
15	Write a Python program to implement K-means clustering.	4	4
16	Write a Python program to implement Principal Component Analysis.	4	4
17	Write a Python program to implement Hierarchal clustering.	4	4
18	Study about architecture of Fuzzy logic system.	5	4
19	Study about AI based biomedical waste management system.	5	4
	Total		**70**

List of Laboratory/Learning Resources Required:

The major equipment/instruments and software required to develop PrOs are given below, with broad specifications to facilitate their procurement by the administrators/management of the institutes. This will ensure the conduction of practical skills in all institutions across the state properly so that the desired skills are developed in students.

Sr. No.	Equipment Name with Broad Specifications	PrO. No.
1	Desktop computers having python (latest version) with AI libraries	ALL
2	AI Trainer kit	ALL
3	AI Workstation with various biomedical sensors, camera, etc.	ALL

Sr. No.	Equipment Name with Broad Specifications	PrO. No.
4	AI and ML GPU based workstation	ALL
5	IoT Builder WorkStation or Trainer kit	ALL

Suggested Project List:

The projects serve as practical learning experiences for students in the field of Biomedical Engineering. These projects integrate theoretical knowledge with hands-on application, fostering competency development across various Course Outcomes (COs). Below are guidelines for designing and executing projects:

- **Project Types:**
  - It can be industry-based, workshop-based, laboratory-based, or field-based.
  - Each project should align with specific COs and address real-world challenges.
- **CO Integration:**
  - It should encompass two or more COs.
  - Integration involves aligning Program Outcomes (PrOs), Unit Outcomes (UOs), and Assessment and Design Outcomes (ADOs).
- **Project Duration:**
  - Students are encouraged to maintain a dated work diary to document their individual contributions and sufficient engagement time for each project should be allocated by faculty during the course.
- **Project Demonstration:**
  - Before submission, students must give a project demonstration on their project.
  - The presentation should highlight the project's objectives, methodology, results, and relevance to industry-oriented COs.
- **Seminar Presentation:**
  - Before submission, students must give a seminar presentation on their project.
  - The presentation should highlight the project's objectives, methodology, results, and relevance to industry-oriented COs.

Following are suggestive projects, and additional ones can be tailored to specific course objectives. Encourage students to explore innovative solutions and apply their engineering skills effectively.

a) Emotion recognition

b) Leaf disease detection and classification
c) Yolo object detection
d) Handwritten digit classification using CNN
e) Audio segmentation
f) Fire detection
g) License plate detection
h) Weather forecasting
i) Sign recognition
j) Posture recognition
k) Biomedical sensors (ECG, Heart Rate, Heart rate & Oximeter Sensor, GSR sensor) interfacing and disease prediction
l) Build a basic model to demonstrate K-means for clustering problems.
m) Build a simple model to demonstrate Random Forest.
n) Build a simple model to demonstrate K-Nearest Neighbor.
o) Build a simple AI based biomedical waste management system.

Suggested Activities for Students: If any

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

- Give seminar on current trends of AI in healthcare.
- Collect healthcare related dataset and apply different AI strategies on it.
- **Expert Lecture or Industry Visit**
  - Activity: Organize a guest talk or visit to a biomedical company.
  - Objective: Relate classroom learning to industry applications.

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