

GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2021 (COGC-2021)

VI – Semester

Course Title: **Artificial Intelligence in Healthcare**

(Course Code: 4360307)

Diploma programme in which this course is offered	Semester in which offered
Bio-Medical Engineering	Sixth

1. 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.

2. COMPETENCY

The purpose of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- Solve basic healthcare problems using artificial intelligence algorithms.

3. COURSE OUTCOMES (COs)

The practical exercises, the underpinning knowledge and the relevant soft skills associated with this competency are to be developed in the student to display the following COs:

- Demonstrate fundamental understanding of the history of artificial intelligence and its types.
- Demonstrate awareness and a fundamental understanding of AI techniques in artificial neural networks.
- Understand the fundamental concepts of supervised learning.
- Understand the fundamental concepts of unsupervised learning.
- Apply basic principles of AI to solve healthcare problems.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P/2)	Examination Scheme				
L	T	P		Theory Marks		Practical Marks		Total Marks
			C	CA	ESE	CA	ESE	
3	0	4	5	30	70	25	25	150

(*): Out of 30 marks under the theory CA, 10 marks are for assessment of the micro-project to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessing the attainment of the cognitive domain UOs required for the attainment of the COs.

Legends: L-Lecture; T – Tutorial/Teacher Guided Theory Practice; P - Practical; C – Credit, CA - Continuous Assessment; ESE - End Semester Examination.

5. SUGGESTED PRACTICAL EXERCISES

The following practical outcomes (PrOs) that are the sub-components of the COs. *Some of the PrOs marked “*” are compulsory, as they are crucial for that particular CO at the ‘Precision Level’ of Dave’s Taxonomy related to ‘Psychomotor Domain’.*

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	2
5	Write programs to Load data sets	3	2
6	Write programs to perform manipulations on data	3	2
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	2*
16	Write a Python program to implement Principal Component Analysis.	4	2
17	Write a Python program to implement Hierarchical clustering.	4	2
18	Study about architecture of Fuzzy logic system.	5	2*
Total			54

Note

- i. More **Practical Exercises** can be designed and offered by the respective course teacher to develop the industry relevant skills/outcomes to match the COs. The above table is only a suggestive list.
- ii. The following are some **sample** ‘Process’ and ‘Product’ related skills (more may be added/deleted depending on the course) that occur in the above listed **Practical Exercises** of this course required which are embedded in the COs and ultimately the competency.
- iii. #*Prerequisites to perform AI based algorithm.

Sr. No.	Sample Performance Indicators for the PrOs	Weightage in %
1	Using the AI libraries through Python.	20
2	Use python to read dataset and modify as per requirement.	20
3	Selecting appropriate AI learning method.	10
4	Train and test the model by importing existing data set.	20

Sr. No.	Sample Performance Indicators for the PrOs	Weightage in %
5	Interpret the result and conclude.	30
Total		100

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

This major equipment with broad specifications for the PrOs is a guide to procure them by the administrators to usher in uniformity of practicals in all institutions across the state.

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,	

7. AFFECTIVE DOMAIN OUTCOMES

The following *sample* Affective Domain Outcomes (ADOs) are embedded in many of the above-mentioned COs and PrOs. More could be added to fulfill the development of this competency.

- a) Work as a leader/a team member.
- b) Follow safety practices.
- c) Practice environmental friendly methods and processes. (Environment related)**

The ADOs are best developed through the laboratory/field based exercises. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

- i. 'Valuing Level' in 1st year
- ii. 'Organization Level' in 2nd year.
- iii. 'Characterization Level' in 3rd year.

8. UNDERPINNING THEORY

Only the major Underpinning Theory is formulated as higher level UOs of *Revised Bloom's taxonomy* in order development of the COs and competency is not missed out by the students and teachers. If required, more such higher level UOs could be included by the course teacher to focus on attainment of COs and competency.

Unit	Unit Outcomes (UOs) (4 to 6 UOs at Application and above level)	Topics and Sub-topics
Unit – I Introduction to Artificial Intelligence	1a. Define Intelligence and Give types of intelligence. 1b. Difference between Human and Machine Intelligence. 1c. Enlist and Explain types of AI. 1d. Summarize history of AI.	1.1. Intelligence: Define, Types, Human and Machine Intelligence. 1.2. Artificial Intelligence (AI): Basic of AI, Strong AI, Weak AI, Reactive machines, Limited

	<p>1e. Justify need for AI. 1f. Differences between AI, machine learning and deep learning. 1g. Give advantages of AI. 1h. Give disadvantages of AI. 1i. Enlist applications of AI.</p>	<p>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</p>
Unit – II Fundamental of Artificial Neural Networks	<p>2a. Summarize history of ANN. 2b. Draw and Explain biological neuron. 2c. Draw and Explain architecture of an artificial neural network. 2d. Give differences between Artificial Neural Network and Biological Neural Network. 2e. Write a short note on Feedback ANN and Feed-Forward ANN. 2f. Write a short note on types of learning. 2g. Give advantages of Artificial Neural Network. 2h. Give disadvantages of Artificial Neural Network. 2i. Enlist applications of Artificial Neural Networks.</p>	<p>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</p>
Unit – III Supervised Learning Models	<p>3a. Define Supervised Learning. 3b. List types of Supervised Learning. 3c. Describe K-Nearest Neighbor. 3d. Describe Simple linear regression. 3e. Give advantage and disadvantage of supervised learning.</p>	<p>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</p>

		<p>Machines, Naive Bayes, K-Nearest Neighbor.</p> <p>3.4 Advantages of Supervised learning.</p> <p>3.5 Disadvantages of Supervised learning.</p>
Unit– IV Unsupervised Learning Models	<p>4a. Define unsupervised learning.</p> <p>4b. Describe working of unsupervised learning.</p> <p>4c. List types of unsupervised learning.</p> <p>4d. Explain K-means algorithm with suitable example.</p> <p>4e. Describe Principal Component Analysis.</p> <p>4f. Give advantage and disadvantage of unsupervised learning.</p> <p>4g. Give difference between Supervised and Unsupervised Learning.</p>	<p>4.1 Introduction of Unsupervised Learning: Define and Working.</p> <p>4.2 Types of Unsupervised learning algorithms: Clustering and Association.</p> <p>4.3 K-means for clustering problems, Principal Component Analysis, Hierarchical clustering, Anomaly detection, Neural Networks.</p> <p>4.4 Advantages of Unsupervised learning.</p> <p>4.5 Disadvantages of Unsupervised learning.</p> <p>4.6 Difference between Supervised and Unsupervised Learning.</p>
Unit– V Application of Artificial Intelligence in Healthcare and advanced algorithms	<p>5a. Draw and Explain architecture of Fuzzy logic system.</p> <p>5b. Give Steps of NLP.</p> <p>5c. Give difference between traditional and AI-based healthcare system.</p> <p>5d. With the help of one example explain application of AI as a post-diseases diagnosis.</p> <p>5e. Describe AI based biomedical waste management system.</p>	<p>5.1 Fuzzy Logic Systems: Introduction, Architecture, Application, Advantages and Disadvantages.</p> <p>5.2 Natural Language Processing (NLP): Introduction, Components and Steps.</p> <p>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</p> <p>5.4 AI based biomedical waste management system.</p>

Note: The UOs need to be formulated at the 'Application Level' and above of Revised Bloom's Taxonomy' to accelerate the attainment of the COs and the competency.

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A	Total Marks
I	Introduction to Artificial Intelligence	7	7	7	0	14
II	Fundamental of Artificial Neural Networks	8	3	7	4	14
III	Supervised Learning Models	10	3	4	7	14
IV	Unsupervised Learning Models	10	3	4	7	14
V	Application of Artificial Intelligence in Healthcare and advance algorithms	7	3	4	7	14
Total		42	26	20	24	70

Legends: R=Remember, U=Understand, A=Apply and above (Revised Bloom's taxonomy)

Note: This specification table provides general guidelines to assist student for their learning and to teachers to teach and question paper designers/setters to formulate test items/questions assess the attainment of the UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary slightly from above table.

10. SUGGESTED STUDENT ACTIVITIES

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.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

- Massive open online courses (**MOOCs**) may be used to teach various topics/sub topics.
- Guide student(s) in undertaking micro-projects.
- 'L' in section No. 4** means different types of teaching methods that are to be employed by teachers to develop the outcomes.
- About **20% of the topics/sub-topics** which are relatively simpler or descriptive in nature is to be given to the students for **self-learning**, but to be assessed using different assessment methods.
- With respect to **section No.11**, teachers need to ensure to create opportunities and provisions for **co-curricular activities**.
- Guide students on how to address issues on environment and sustainability.
- Guide students for using data manuals.

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project is group-based. However, in the fifth and sixth semesters, it should be preferably be **individually** undertaken to build up the skill and confidence in every student to become problem solver so

that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should **not exceed three**.

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than **16 (sixteen) student engagement hours** during the course. The student ought to submit micro-project by the end of the semester to develop the industry-oriented COs.

A suggestive list of micro-projects is given here. This has to match the competency and the COs. Similar micro-projects could be added by the concerned course teacher:

- 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.**

13. SUGGESTED LEARNING RESOURCES

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)

Sr. No.	Title of Book	Author	Publication with place, year and ISBN
6	Introduction to Artificial Intelligence and Expert Systems	Petterson, D.W.,	Prentice Hall of India (2007)

14. SOFTWARE/LEARNING WEBSITES

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

15. PO-COMPETENCY-CO MAPPING

Semester VI	Artificial Intelligence in Healthcare (Course Code: 4360307)						
	POs						
Competency & Course Outcomes	PO 1 Basic & Discipline specific knowledge	PO 2 Problem Analysis	PO 3 Design/development of solutions	PO 4 Engineering Tools, Experimentation & Testing	PO 5 Engineering practices for society, sustainability & environment	PO 6 Project Management	PO 7 Life-long learning
Competency "Solve basic healthcare problems using artificial intelligence algorithms."							
CO a) Demonstrate fundamental understanding of the history of artificial intelligence and its types.	2	2	1	1	2	1	3
CO b) Demonstrate awareness and a fundamental understanding of AI techniques in artificial neural networks.	2	2	2	3	1	2	2
CO c) Understand the fundamental concepts of supervised learning.	2	2	3	3	2	3	2
CO d) Understand the fundamental concepts of unsupervised learning.	2	2	3	3	2	3	2
CO e) Apply basic principles of AI to solve healthcare problems.	2	3	3	3	2	3	2

Legend: '3' for high, '2' for medium, '1' for low or '-' for the relevant correlation of each competency, CO, with PO/ PSO

16. COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons

Sr. No.	Name and Designation	Institute	Contact No.	Email
1	Dr. Rahulsinh B. Chauhan (Lecturer)	Government Polytechnic, Gandhinagar	9687275484	rahulsinh.04@gmail.com
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