GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2022 (COGC-2022)
Semester- IV

Course Title: Artificial Intelligence
(Course Code: 4341707)

Diploma program in which this course is offered	Semester in which offered
Instrumentation and Control Engineering	4th Semester

1. RATIONALE

To introduce the concept of artificial intelligence, methods, techniques and applications.

2. COMPETENCY ('Program Outcome' according to NBA Terminology)

The course content should be taught and implemented with the aim to develop different types of skills so that students are able to acquire following competency:

- **Conceptualize fundamentals of Artificial Intelligence and Machine Learning 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:

a) To familiarize the student with basic concepts of AI algorithms
b) To introduce the students to the basic concepts and role of experts system in instrumentation and control
c) Explain the concept of Artificial Neural Networks, Learning and Pattern Classification
d) Illustrate the concept of fuzzy logic and its applications

e) To provide understanding of the concepts of ML algorithms and Natural Language Processing

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P/2)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CA	ESE	CA	ESE	
3	0	2	4	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) are the sub-components of the COs.

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
1	Install suitable tools to explore and implement Expert System for various industrial applications	2	2
2	Install suitable python IDE with all required modules.	2	2
3	Write a program to create word cloud using Python	2	2
4	Load basic library of python for machine learning to be used in Raspberry PI	2	2
5	Implement Decision making on the basis of input data on raspberry PI	2	2
6	Write a program for Back Propagation Algorithm	3	2
7	demonstrate the ability of a multilayer feedforward neural network	3	2
8	Design of a Fuzzy controller for FAN speed controller using Fuzzy tool	4	2
9	Implement a program for matching two strings using fuzzy logic in Python	4	2
10	Implementing K-Means clustering algorithm.	5	2
11	Implementation of linear and polynomial regression	5	2
12	Implementation of logistic regression or binary classification.	5	2
13	Write a program to implement K-nearest Neighbour algorithm	5	2
14	Implement the program for text pre-processing in python	6	2
15	Write a program to demonstrate sentiment analysis in python	6	2

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.

S. No.	Sample Performance Indicators for the PrOs	Weightage in %
1	Prepare of experimental setup	20
2	Operate the equipment setup or circuit	20
3	Follow safe practices measures	10
4	Record observations correctly	20
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 practical in all institutions across the state.

    i.   High performance GPU based server
    ii. IDE for development
    iii. Various supporting open source software

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 while using electrical appliances.
    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 studentsand teachers. If required, more such higher level UOs could be included by the course teacher to focus on attainment of COs and competency.

Unit	Major Learning Outcomes ('Course Outcomes' in Cognitive Domain according to NBA terminology)	Topics and Sub-topics
Unit – I Introduction of Artificial Intelligence	1a.Explain concept and importance of Artificial Intelligence 1b. Differentiate Human Intelligence from Machine Intelligence 1c. Describe Agents and its structure	1.1 Introduction to AI 1.2 The concept and importance of AI 1.3 Human intelligence vs. Machine intelligence 1.4 Agents and Environments, the concept of rationality, the nature of environments, and structure of agents.

Unit – II Expert Systems	2a.Explain advantages and disadvantages of expert system 2b. Describe expert system architecture 2c. Explain types of expert system 2d. Define role of expert system in instrumentation and process control	2.1	Expert systems: advantages, disadvantages
		2.2	Expert system architecture
		2.3	Functions of various parts
		2.4	Mechanism and role of inference engine
		2.5	Types of Expert system
		2.6	Tuning of expert systems
		2.7	Role of Expert systems in instrumentation and process control
Unit – III Artificial Neural Networks	3a.Explain function of single neuron 3b. Classify various Artificial neuron models 3c. Draw neural network architecture 3d. Apply neural network for classification algorithm	3.1	Structure and function of a single neuron
		3.2	Artificial neuron models
		3.3	Types of activation functions
		3.4	Neural network architectures
		3.5	Neural learning, Evaluation of networks
		3.6	Supervised learning, Back propagation take all networks,
		3.7	Application of neural networks for Classification−algorithm
		3.8	Unsupervised learning, winner Clustering, Pattern associations, Function approximation, Forecasting etc
Unit – IV Fuzzy Logic	4a.Introduce fuzzy logic 4b. Differentiate Conventional set vs. fuzzy set 4c. Describe fuzzy rules and inference 4d. Apply fuzzy logic to the control system.	4.1	Introduction to Fuzzy Logic
		4.2	Conventional set vs. Fuzzy set
		4.3	Operations of fuzzy set
		4.4	Membership function
		4.5	Fuzzy rules, Fuzzy inference
		4.6	De-fuzzification
		4.7	Application for control

Unit – V Basics of Machine Learning	5a.Ellaborate basics of Machine Learning 5b. Classify Supervised Learning 5c. Classify Unsupervised Learning 5d. Describe Reinforcement Learning	5.1 Introduction to Machine Learning 5.2 Regression 5.3 Classification 5.4 Clustering 5.5 Supervised learning (Linear Regression, Decision Trees, Learning Decision Trees, K-nearest Neighbor) 5.6 Unsupervised learning (K-means, Dimensionality reduction, Linear Discriminate Analysis(LDA) 5.7 Reinforcement learning
Unit – VI Natural Language Processing	6a.Explain concept of natural language processing 6b. Define syntactic processing 6c. Apply NLP to create Chatbot using one of the industrial example	6.1 Introduction to NLP 6.2 Syntactic Processing 6.3 Semantic Analysis 6.4 Discourse and Pragmatic Processing, Text Analytics, Text pre-processing 6.5 Bag of Words, Word Cloud 6.6 Machine Translation 6.7 Sentiment analysis 6.8 AI Chatbots

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	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Introduction of Artificial Intelligence	04	02	03	00	05
II	Expert Systems	08	05	05	05	15
III	Artificial Neural Networks	08	05	05	05	15
IV	Fuzzy Logic	06	02	02	06	10
V	Basics of Machine Learning	10	05	05	05	15
VI	Natural Language Processing	06	02	02	06	10
	Total	**42**	**21**	**22**	**27**	**70**

Legends: R = Remember; U = Understand; A = Apply and above levels (Bloom's revised taxonomy)
Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

10. SUGGESTED LIST OF STUDENT ACTIVITIES

Following is the list of proposed student activities such as:

   i.   Students may be asked to collect photographs using internet which is relevant to field application of various topics and have to prepare learning materials using it.
   ii. Teachers guided self learning activities, Course/library/internet/lab based mini projects, industrial visit etc.
   iii. Students activities like: course/ topic based seminars, Internet based assignments.

   iv. Students should deliver a seminar in groups on materials used in various Digital Techniques and advances/latest trends in Digital Techniques.

11.   SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

   i.   Take small instrumentation components to the class when teaching
   ii. Internet based home assignments
   iii. Mini project

12.   SUGGESTED MICRO-PROJECTS

   I.   Implement AI Chatbots for any one industrial application

   II. Implement one industrial application using ChatGPT

13.   SUGGESTED LEARNING RESOURCES

Sr. No.	Title of Books	Author	Publication
1	Artificial Intelligence	Elaine Rich and Kevin Knight	Tata McgrawHill(2nd Edition)
2	Artificial Intelligence: A Modern Approach	Stuart J. Russell and Peter Norvig	Pearson Education, 3rd Edition
3	Machine Learning with Python for Everyone	Mark Fenner	Pearson Education
4	Machine Learning	Anuradha Srinivasaraghavan, Vincy Joseph	Wiley
5	Machine Learning with Python	U Dinesh Kumar Manaranjan Pradhan	Wiley
6	Neural Networks, Fuzzy Logic, and Genetic Algorithms: Synthesis and Applications	S. Rajshekharan, G. A. Vijayalakshmi Pai	PHI
7	Introduction to Artificial Intelligence and Expert Systems	Petterson, D.W.,	Prentice Hall of India (2007)

14.   List of Software/Learning Websites
   i.   www.nptel.com
   ii.   http://vlab.co.in/
   iii.   www.isa.org
   iv.   http://nptel.ac.in/video.php
   v.   http://www.idc-online.com
   vi.   https://nptel.ac.in/courses/106105077
   vii.   https://www.coursera.org/learn/introduction-to-ai#about
   viii. https://ai.google/education/
   ix.   https://www.javatpoint.com/artificial-intelligence-tutorial
   x.   https://www.geeksforgeeks.org/artificial-intelligence-an-introduction/

15.   PO-COMPETENCY-CO MAPPING

Semester I	Digital Techniques(Course Code: 4331701)						
	POs						
Competency & Course Outcomes	**PO 1** Basic & Discipline specific knowledge	**PO 2** Problem Analysis	**PO 3** Design/ develop- ment of solutions	**PO 4** Engineering Tools, Experimen- tation& Testing	**PO 5** Engineering practices for society, sustainability & environment	**PO 6** Project Manage- ment	**PO 7** Life-long learning
Competency	"Conceptualize fundamentals of Artificial Intelligence and Machine Learning Algorithms."						
CO1: To familiarize the student with basic concepts of AI algorithms	3	1	1	0	2	0	3
CO2: To introduce the students to the basic concepts and role of experts system in instrumentation and control	2	1	2	1	2	3	2
CO3: Explain the concept of Artificial Neural Networks, Learning and Pattern Classification	2	2	1	3	1	3	3
CO4: Illustrate the concept of fuzzy logic and its applications	2	1	2	2	1	2	2
CO5: To provide understanding of the concepts of ML algorithms and Natural Language Processing	3	2	3	3	3	2	3

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

Member – Board of Studies (GTU), Electrical and Allied branches

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