GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

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

Course Title: Fundamentals of Artificial Intelligence
(Course Code: 4350705)

Diploma programme in which this course is offered	Semester in which offered
Computer Engineering	5th semester

1.   RATIONALE

Artificial intelligence is an expansive branch of computer science that focuses on building smart machines. Thanks to AI, these machines can learn from experience, adjust to new inputs, and perform human-like tasks. AI is more popular than ever today due to increased data volumes, advancements in computing and storage and advanced algorithms. We encounter several examples of artificial intelligence in our daily lives. From Netflix's movie recommendation to Amazon's Alexa, we now rely on various AI models without knowing it. Hence, every student of Computer Engineering must therefore understand the blue prints of artificial intelligence and must be able to apply AI on available data. This course will help students to build up core competencies in understanding different concepts of AI.

2.   COMPETENCY

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

- **Conceptualize the basic ideas and techniques underlying the design of AI systems.**

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) Identify different AI techniques and its applicable areas.
b) Classify different problem characteristics and algorithms for AI
c) Illustrate the issues in knowledge representation and the use of resolution procedures for solving AI problems
d) Illustrate the components, development phases and applications of Expert Systems
e) Perform case studies on different available AI systems

4.   TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T/2+P/2)	Examination Scheme				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	CA	ESE	CA	ESE	
3	-	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 subcomponents of the COs. . . . These PrOs need to be attained to achieve the COs.

Sr. No.	Practical Outcomes (PrOs)	Unit	Approx. Hrs.
1	Study about NumPy library of Python.	1	1
2	Study about Scikit library of Python.	1	1
3	Study about Panda library of Python.	1	1
4	Develop a program that read rules from the rules file and acts accordingly for given user input. For this, create a text file of five rules of any situation and ask the user to give input and according to the rules give the response.	2	2
5	Read data from a CSV file using panda library.	2	1
6	Write a python program to generate Calendar for the given month and year?	2	1
7	Write a python program to implement Breadth First Search Traversal?	2	2
8	Write a program to implement Tic-Tac-Toe game using python.	2	2
9	Perform math functions using NumPy library.	3	2
10	Identify the missing values from given CSV file.	3	2
11	Write a program to identify the noisy value of the age data set.	3	2
12	Write a python program to implement simple Chatbot	3	2
13	Write a python program to remove stop words for a given passage from a text file using NLTK?	4	2
14	Write a python program to for Text Classification for the give sentence using NLTK?	4	2
15	Study about how to asking ChatGPT to Write Complex Algorithms	5	2
16	Study about Movie recommendation based on emotion in Python	5	2
	Total		28

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..*

Sr. No.	Sample Performance Indicators for the PrOs	Weightage in %
1	Analyze given problem and find possible solution methods	25
2	Select appropriate algorithm/method to solve the problem	10
3	Use python libraries to implement solution	25
4	Test the model solution by different data sets	20
5	Making predictions and improve learning parameters as well as improve accuracy.	20
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.

Sr. No.	Equipment Name with Broad Specifications	PrO. No.
1	Computer system with operating system: Windows 7 or higher Ver., macOS, and Linux, with 4GB or higher RAM, Python versions: 2.7.X, 3.6.X	All
2	Python IDEs and Code Editors Open Source: Anaconda Navigator	

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 Data scientist.
   b) Follow ethical practices.

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 the 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. Describe different AI techniques 1b. Summarize applications of AI	1.1 The AI Problem 1.2 The Underlying Assumption 1.3 AI Techniques 1.4 The level of model 1.5 Criteria for success 1.6 Application of AI
Unit – II **State Space Search and Heuristic Technique**	2a. Discuss different problem characteristics for solving AI problems 2b. Illustrate algorithms to solve AI problems	2.1 Solving problems as state space search 2.2 Production system 2.3 Problem characteristics 2.4 Depth First Search 2.5 Breadth-First Search 2.6 Heuristic function 2.7 Hill climbing 2.8 Best First Search
Unit– III **Knowledge Representation**	3a. Explain different issues in Knowledge Representation 3b. Compare Forward and Backward Reasoning 3c. Use resolution procedures to solve AI problems	3.1 Knowledge Representation 3.2 Issues in Knowledge Representation 3.3 FIRST ORDER LOGIC 3.4 Computable function and predicates 3.5 Forward/Backward reasoning 3.6 Unification and Lifting 3.7 Resolution procedure 3.8 Logic programming
Unit– IV **Expert System**	4a. Describe the basic building blocks and development phases of the Expert System 4b. Discuss the importance of knowledge acquisition for Expert System	4.1 Expert System 4.2 Building Blocks of Expert System 4.3 Development phases of Expert System 4.4 Expert System-shell 4.5 Explanations 4.6 Knowledge Acquisition 4.7 Application of the expert system
Unit– V **AI Case Studies**	5a. Perform case studies on different available AI systems	5.1 Chatbots 5.2 ChatGPT 5.3 Recommendation Algorithm 5.4 Digital (Voice) Assistant 5.5 Virtual Face Filters

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 Level	Total Marks
I	Introduction to artificial intelligence	08	04	06	04	14
II	State Space Search and Heuristic Technique	12	06	08	04	18
III	Knowledge Representation	08	04	06	04	14
IV	Expert System	08	04	06	04	14
V	AI Case Studies	06	02	06	02	10
	Total	**42**	**20**	**32**	**18**	**70**

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

<u>***Note***</u>: *This specification table provides general guidelines to assist students 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 the 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:
   a) Explore different algorithms and methods to solve AI problems.
   b) Undertake micro-projects in teams
   c) Give a seminar on any relevant topics.

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:
   a) Massive open online courses (***MOOCs***) may be used to teach various topics/subtopics.
   b) Guide student(s) in undertaking micro-projects.
   c) ***'L' in section No. 4*** means different types of teaching methods that are to be employed by teachers to develop the outcomes.
   d) 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.
   e) With respect to ***section No.10***, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
   f) Guide students for open-source python editors.

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 are 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 a dated work diary consisting of individual contributions 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 a 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:

- **Resume Parser**
- **Chatbots**
- **Animal Species Prediction System**
- **Object Detection System**
- **Facial Emotions Recognition System**
- **Autocorrect Tool**

13.   SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication with place, year and ISBN
1	Artificial Intelligence, 3rd ed	Elaine Rich, Kevin Knight, Shiv Shankar B Nair	TMH (Tata McGraw Hill)
2	A First Course in Artificial Intelligence	Deepak Khemani	TMH (Tata McGraw Hill)
3	Artificial Intelligence: A Modern Approach, 2nd ed	Stuart Russell and Peter Norvig	Pearson
4	Introduction to Artificial Intelligence and Expert Systems	Dan W. Patterson	PHI (Prentice Hall of India)

14.   SOFTWARE/LEARNING WEBSITES

   a.   https://www.geeksforgeeks.org/artificial-intelligence-an-introduction/
   b.   https://www.tutorialspoint.com/artificial_intelligence/index.htm
   c.   https://www.britannica.com/technology/artificial-intelligence
   d.   https://nptel.ac.in/

e. https://www.coursera.org/
f. https://scikit-learn.org/

15. PO-COMPETENCY-CO MAPPING

Semester V	Fundamentals of Artificial Intelligence (Course Code: 4350705)						
	POs and PSOs						
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 Conceptualize the basic ideas and techniques underlying the design of AI systems.							
Course Outcomes CO a) Identify different AI techniques and its applicable areas.	2	-	-	-	-	-	3
CO b) Classify different problem characteristics and algorithms for AI	2	2	3	3	-	2	3
CO c) Illustrate the issues in knowledge representation and the use of resolution procedures for solving AI problems	2	3	3	3	-	2	3
CO d) Illustrate the components, development phases and applications of Expert Systems	2	2	2	2	-	2	3
CO e) Perform case studies on different available AI systems	2	3	3	3	-	3	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

GTU Resource Persons

Sr. No.	Name and Designation	Institute	Email
1	Mrs. Manisha P. Mehta – Head (Comp)	Government Polytechnic Himmatnagar	manishamehtain@gmail.com
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