COURSE TITLE	**ARTIFICIAL AND COMPUTATIONAL INTELLIGENCE**
COURSE CODE	**01CO0215**
COURSE CREDITS	**4**

Objective:

1 This course aims to provide students with an advanced perspective on Artificial Intelligence and its foundational principles. It will also focus on the practical relevance of key concepts, paradigms, and algorithms in the fields of engineering and computer science. The course will introduce students to fundamental tools and techniques in computational intelligence, with a focus on neural networks, genetic algorithms, and other biologically inspired computing models, enabling them to apply these methods to solve real-world problems.

Course Outcomes: After completion of this course, student will be able to:

1 Understand the basics of AI, intelligent agents, and fuzzy logic.

2 Apply simple machine learning techniques for classification and clustering.

3 Build basic neural networks, their architectures and training techniques.

4 Explain the basic concepts of Computational Intelligence including evolutionary algorithms.

5 Analyze problems through real-world case studies using Hybrid Computational AI systems.

Pre-requisite of course: Programming Basics, Artificial Intelligence Basics.

Teaching and Examination Scheme

Theory Hours	Tutorial Hours	Practical Hours	ESE	IA	CSE	Viva	Term Work
3	0	2	50	30	20	25	25

Contents : Unit	Topics	Contact Hours
1	**Fundamentals of Artificial Intelligence:** Introduction to AI, Intelligent agents and environments, Problem formulation, Search techniques-Uninformed and informed, DFS, A*,AO* Knowledge representation methods., Introduction to Fuzzy Logic:, Fuzzy sets and membership functions, Fuzzy rules and reasoning	8
2	**Role of Machine Learning** Introduction to machine learning., Types of machine learning-Supervised Learning, Classification and Regression-Unsupervised, Learning-K-Means Clustering-Ridge Regression.	9

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Contents : Unit	Topics	Contact Hours
3	**Introduction to Neural Networks** Biological and artificial neuron, neural networks, supervised and unsupervised learning., Single layer Perceptron, Multilayer Perceptron – Back propagation learning, Gradient descent optimization, Overfitting and regularization, Hyper parameter tuning, Kohonen's Self- Organizing Networks – Hopfield Networks, Introduction to Advanced Architectures:, CNN, RNN and Auto encoders.	9
4	**Introduction to Computational Intelligence** types of Computational Intelligence, components of Computational Intelligence, Concept of Learning/Training model. Parametric, Models, Nonparametric, Introduction to Evolutionary Algorithms, Biological inspiration, Genetic algorithms (GA), Evolution strategies (ES), Genetic programming (GP),, Genetic Algorithms: Representation and initialization, Convergence and diversity maintenance, Overview of particle swarm optimization (PSO) and ant colony optimization (ACO)	9
5	**Hybrid Computational Intelligence Systems** Neuro-fuzzy systems,, Genetic-fuzzy systems, Applications and case studies	7
Total Hours		**42**

Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
1	**Practical 1** Introduction to Artificial Intelligence Tools and Applications: Explore real-life AI systems and tools	2
2	**Practical 2** Create a basic rule-based or decision-making agent in a virtual environment	2
3	**Practical 3** Visualization of Search Strategies	2
4	**Practical 4** Hands-on with Machine Learning Environments	2
5	**Practical 5** Building a Simple Classifier	2
6	**Practical 6** Introduction to Clustering Concepts:to understand unsupervised learning	2
7	**Practical 7** Getting Started with Neural Networks: Understand neural network layers and simulate a basic one using any tools	2
8	**Practical 8** Visualizing the Learning Process in Neural Networks	2

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Suggested List of Experiments:

Contents : Unit	Topics	Contact Hours
9	**Practical 9** Exploring Fuzzy Logic with Real-life Examples	2
10	**Practical 10** Understanding Computational Intelligence Paradigms	2
11	**Practical 11** Demo of Genetic Algorithm for Optimization	2
12	**Practical 12** Basics of Swarm Intelligence: Use animation/simulation tools to visualize behaviour of ant colony or particle swarms	2
13	**Practical 13** Introduction to Hybrid Systems: Understand the concept of hybrid AI systems and real-world use cases	2
14	**Practical 14** Mini Project: Concept to Application: Design a basic AI/CI model for a selected case study	2
Total Hours		**28**

Textbook :

1 Introduction to Artificial Intelligence and Expert Systems, Dan W.Patterson, PHI, 2006

References:

1 Neural Networks – A Classroom Approach, Neural Networks – A Classroom Approach, Kumar S.,, Tata McGraw Hill, 2004

2 Computational Intelligence: Principles, Techniques and Applications, Computational Intelligence: Principles, Techniques and Applications, Konar A.,, Springer Verlag, 2005

3 The Hundred-Page Machine Learning Book Hardcover, The Hundred-Page Machine Learning Book Hardcover, Andriy Burkov, Andriy Burkov, 2019

4 Fundamentals of Neural Networks, Fundamentals of Neural Networks, Laurence Fausett, Prentice Hall, 1994

5 Computational Intelligence: Synergies of Fuzzy Logic, Neural Networks and Evolutionary Computing, Computational Intelligence: Synergies of Fuzzy Logic, Neural Networks and Evolutionary Computing, NazmulSiddique, HojjatAdeli, Willey, 2013

Suggested Theory Distribution:

The suggested theory distribution as per Bloom's taxonomy is as follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

Distribution of Theory for course delivery					
Remember / Knowledge	**Understand**	**Apply**	**Analyze**	**Evaluate**	**Higher order Thinking / Creative**
0.00	10.00	30.00	30.00	25.00	5.00

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Instructional Method:

1. The course delivery method will depend upon the requirement of content and the needs of students. The teacher, in addition to conventional teaching methods by black board, may also use any tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc.
2. The internal evaluation will be done on the basis of continuous evaluation of students in the laboratory and class-room.
3. Practical examination will be conducted at the end of semester for evaluation of performance of students in the laboratory.
4. Students will use supplementary resources such as online videos, NPTEL videos, e-courses, Virtual Laboratory.

Supplementary Resources:

1. https://developers.google.com/machine-learning/intro-to-ml
2. https://www.coursera.org/learn/ai-for-everyone
3. https://www.simplilearn.com/tutorials/deep-learning-tutorial/neural-network
4. https://scinet.usda.gov/training/free-online-training
5. https://www.youtube.com/watch?v=hE7Wi5OuRQ0
6. https://www.datacamp.com/tutorial/genetic-algorithm-python

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