INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal - 500 043, Hyderabad, Telangana

COURSE CONTENT

COMPUTATIONAL AI								
VI Semester: CSE (AI & ML)								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
ACAD34	**Elective**	3	-	-	3	40	60	100
Contact Classes: 45	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 45**		
Prerequisite: Basic Principles of Algebra and Calculus								

I. COURSE OVERVIEW:
Computational AI (CA) deals with nature-inspired computational methodologies and approaches to solve complex problems for real world challenges to which traditional methodologies and approaches are ineffective or infeasible. This course helps in designing and developing intelligent systems. It will focus on the main CA approaches and methodologies, namely artificial neural networks, genetic algorithms, swarm optimization, and fuzzy systems. It is a research-based course and helps the students to investigate the current state of research in CA areas as well as to gain comprehensive theoretical knowledge from scientific research. It helps the students to understand real world applications of CA approaches and guides them to use their theoretical knowledge to design and build CA algorithms for solving real world problems.

II. COURSE OBJECTIVES:
The students will try to learn:

I The fundamentals of key intelligent systems technologies.
II The key concepts of Artificial neural networks, fuzzy expert systems, deep neural networks and evolutionary computation.
III Gain understanding of swarm intelligence principles focusing on network structures and parameters.
IV The integration of intelligent systems technologies for engineering applications.

III.COURSE OUTCOMES:
At the end of the course students should be able to:

CO 1 Outline the soft computing methods of rule-expert system, uncertainty management, fuzzy expert systems to solve real-time problems involving uncertainty and complexity.
CO 2 Utilize fundamental principles to design and train neural networks for solving supervised and unsupervised learning tasks.
CO 3 Select appropriate solutions with chromosome representation, fitness function and selection mechanisms to solve optimization problems.
CO 4 Explore genetic algorithms and genetic programming with strategic crossover, mutation to uncover data models.
CO 5 Interpret swarm intelligence principles, particle swarm optimization algorithms, swarm hybrids and hybrid optimizations to solve real-world problems.
CO 6 Implement real-world applications like character recognition, robotics vehicle efficiency and color prediction to analyze case studies of techniques.

IV.COURSE CONTENT:

MODULE - I: INTRODUCTION TO COMPUTATIONAL INTELLIGENCE (09)
Introduction to Computational Intelligence: Intelligence machines, Computational intelligence paradigms, History, Expert Systems: Rule-based expert systems, Uncertainty management, Fuzzy expert systems: Fuzzy sets and operations of fuzzy sets, Fuzzy rules and fuzzy inference, Fuzzy expert systems.

MODULE - II: ARTIFICIAL NEURAL NETWORKS (09)
Artificial Neural Networks: Fundamental neurocomputing concepts: artificial neurons, activation functions, neural network architectures, learning rules - Supervised learning neural networks: multi-layer feed forward neural networks, simple recurrent neural networks, time-delay neural networks, supervised learning.

Unsupervised learning neural networks: self-organizing feature maps, Radial basis function networks, Deep neural networks and learning algorithms.

MODULE - III: EVOLUTIONARY COMPUTATION (09)
Evolutionary Computation: Representation: Chromosomes-fitness functions, selection mechanisms.
Genetic algorithms: crossover and mutation, Genetic programming**.**

MODULE – IV: HYBRID INTELLIGENT SYSTEMS (09)
Swarm Intelligence: Basic Particle Swarm Optimization, Social Network Structures, Basic Variations, Basic PSO Parameters, Single-Solution Particle Swarm Optimization Neuro-swarm Hybrids, Fuzzy-Swarm Hybrids, Hybrid Optimization Approach, Applications.

MODULE – V: APPLICATIONS (09)
Applications and case studies: Printed Character Recognition, Inverse Kinematics Problems, Automobile Fuel Efficiency Prediction, Soft Computing for Color Recipe Prediction, Case studies.

V.TEXTBOOKS:

1. A.P. Engelbrecht, “Computational Intelligence: An Introduction”, 2012, 2nd edition, John Wiley & Sons.
2. S.Rajasekaran, G.A. Vijayalakshmi Pai, “Neural Networks, Fuzzy logic and Genetic Algorithms-Synthesis and Applications”, PHI Learning, 2003.

VI.ELECTRONICS RESOURCES:

1. https:// https://dl.acm.org/doi/10.5555/1212847/
2. https:// www.engati.com/glossary/computational-intelligence

VII.MATERIAL ONLINE:

1. Course template
2. Tech-talk topics
3. Assignments
4. Definition and terminology
5. Tutorial question bank
6. Model question paper – I
7. Model question paper – II
8. Lecture notes
9. Early lecture readiness videos (ELRV)
10. PowerPoint presentations