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

COURSE CONTENT

BIO-INSPIRED COMPUTING								
VII Semester: CSE (AI&ML)								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
ACAD24	Elective	3	0	0	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisites: Deep Learning, / Cloud Computing								

I. COURSE OVERVIEW:

This course is strongly grounded on the foundations of complex systems and theoretical biology. It aims to provide an understanding of the distributed architectures of natural complex systems, and how those can be used to produce informatics tools with enhanced robustness, scalability, flexibility and which can Interface more effectively with humans. It is a multi-disciplinary field strongly based on biology, complexity, Computer science, informatics, cognitive science, robotics, and cybernetics.

II. COURSE OBJECTIVES:

The students will try to learn:

I. The fundamentals of evolutionary theory and cellular automata.
II. The artificial neural systems and swarm optimization for feature selection.
III. The genetic algorithm and hybridization with mimetic algorithms.
IV. The basic features of neural and immune systems and able to build the neural model

III. COURSE OUTCOMES:

At the end of the course, student should be able to:

CO1 Outline phenomena guiding bio-logical processes through self-organization and Adaptability.
CO2 Utilize the features of neural and immune systems for building the neural model Using Real-world challenges in optimizing alignment.
CO3 Develop genetic and Particle Swarm Optimization using simple bio-inspired Algorithms.
CO4 Solve the optimization problems, with a specific focus on job scheduling with the help of Genetic algorithms.
CO5 Make Use of artificial immune systems to solve complex problems by adapting the principles of biological immune systems.
CO6 Summarize the behavioral systems of biological principles in robotics from cognitive science and AI.

IV. COURSE CONTENT:

MODULE – I: INTRODUCTION TO EVOLUTIONARY ALGORITHMS (10)

Introduction to Evolutionary Algorithms: Components of evolutionary algorithm representation, Evaluation function, Population, parent selection mechanism, Variation operators, Survivor selection mechanism, Initialization, Termination condition, evolutionary algorithm case study, cellular systems, cellular automata, modeling with cellular systems, other cellular systems, computation with cellular systems, artificial life: analysis and synthesis of cellular systems.

MODULE – II: NEURAL SYSTEMS (09)

Neural Systems: Biological nervous systems, artificial neural networks, neuron models, architecture, signal Encoding synaptic plasticity, unsupervised learning, supervised learning, reinforcement learning, evolution of neural networks, hybrid neural systems, case study.

MODULE – III: SPECIAL MEMBER FUNCATIONS AND OVERLADING (10)

Genetic Algorithms: Basics of genetic algorithms, Representation of individuals, Mutation, Crossover, Mutation, Recombination, Population Models, Parent Selection, Survivor Selection, and Applications of GAs in Optimization problems application: Solving a job shop scheduling problem.

Collective Systems: Biological self-organization, Particle Swarm Optimization (PSO), ant colony optimization (ACO), Swarm robotics, co-evolutionary dynamics, artificial volition of competing systems, artificial evolution of cooperation, Case study.

MODULE – IV: DEVELOPMENTAL AND IMMUNE SYSTEMS (09)

Immune Systems: Rewriting system, synthesis of developmental system, evolutionary rewriting systems, Evolutionary developmental programs, and biological immune systems, lessons for artificial immune systems, Algorithms and applications, shape space, negative selection algorithm, clonal selection algorithm.

MODULE – V: BEHAVIORAL SYSTEMS (10)

Behavioral Systems: Behavior is cognitive science, behavior in AI, behavior-based robotics, biological inspiration for robots, robots as biological models, robot learning, evolution of behavioral systems, learning in behavioral Systems, co-volute ion of body and control, towards self-reproduction, simulation and reality.

V. TEXTBOOKS:

1. Zhou, Zhi-Hua. Ensemble Methods: Foundations and Algorithms. United Kingdom, Taylor & Francis, 2012.

VI. REFERENCE BOOKS:

1. D.E.Goldberg, “Genetic algorithms in search, optimization, and machine learning”, Addison-Wesley,1989.
2. SimonO.Haykin,“NeuralNetworksandLearningMachines”,PrenticeHall,3rdEdition2008.
3. M. Dorigo, T. Stutzle,“Ant Colony Optimization”,ABradford Book,2004.
4. R.C.Ebelhart,“SwarmIntelligence”,MorganKaufmann,2001.

VII. WEB REFERENCES

1. http://www.cse.msstate.edu/~ioana/Courses/CSE9133.html
2. www.cse.msstate.edu/academics/gradstud/honesty.php
3. https://www.analyticsvidhya.com/blog/2021/04/artificial-neural-network-its-inspiration-and-the-working-
4. https://nptel.ac.in/courses/106/105/106105173/

5. http://www.ai.eecs.umich.edu/

VIII. MATERIALS ONLINE

1. Course template
2. Tutorial question bank
3. Tech talk topics
4. Open-ended experiments
5. Definitions and terminology
6. Assignments
7. Model question paper – I
8. Model question paper – II
9. Lecture notes
10. PowerPoint presentation
11. E-Learning Readiness Videos (ELRV)