INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal - 500 043, Hyderabad, Telangana

COURSE CONTENT

EVOLUTIONARY COMPUTING								
VI Semester: CSE (AI&ML)								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
ACAD17	**Elective**	3	0	0	3	40	60	100
Contact Classes: 48	**Tutorial Classes: Nil**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisites: No Prerequisites								

I. COURSE OVERVIEW:

The aim of the course is to provide a firm grounding in Evolutionary Computing along with Genetic Algorithms (GAs). It provides a study of computational algorithms that are used for optimization and problem-solving and are based on the principles of biological evolution. The applications are machine learning Algorithms, Optimization Problems, Robotics, Game Playing for Engineering.

II. COURSE OBJECTIVES:

The students will try to learn:

I. Evolutionary algorithms (EAs) encapsulate the fundamental evolutionary process and draw insights from historical perspectives.
II. Canonical evolutionary algorithms and their applications to be implemented in diverse problem-solving scenarios.
III. Evolutionary algorithms, emphasizing reproductive mechanisms and their customization for diverse optimization tasks.
IV. The wide range of applications of evolutionary algorithms showcase excellence across a broad spectrum of scenarios.

III. COURSE OUTCOMES:

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

CO1 Understand the basic concepts and history of EAs to effectively leverage EAs for addressing a wide range of challenges across different domains.
CO2 Apply appropriate evolutionary algorithms for a given problem to find high-quality solutions.
CO3 Understand the evolutionary algorithms for solving complex optimization problems.
CO4 Analyze the state-of-the-art evolutionary computation research literature in solving practical problems.
CO5 Make use of Evolutionary algorithms as problem solvers in the field of optimization, machine learning, robotics, automated programming, and adaptation.
CO6 Choose suitable evolutionary algorithms for a real-world application to address complex, dynamic, and large-scale problems.

IV. COURSE CONTENT:

MODULE – I: BASIC EVOLUTIONARY PROCESS (10)
Introduction: Basic evolutionary process, a simple evolutionary system, EV on a simple landscape, EV on a more complex fitness landscape. Evolutionary systems as problem solvers. A historical perspective, other EA applications.

MODULE – II: CANONICAL EVOLUTIONARY ALGORITHMS (09)
Canonical Evolutionary algorithms: Introduction, Evolution programming, evolution strategies, GA: multi-parent reproduction, Universal genetic codes.

MODULE – III: A UNIFIED VIEW AND REPRODUCTIVITY MECHANISMS (10)
A Unified view: A common framework, Population Size: parent and offspring population, Selection: choosing selection mechanisms, survival selection.

Reproductive Mechanisms: Mutation, recombination, crossover or mutation, representation issues, choosing effective reproductive mechanism.

MODULE – IV: EVOLUTIONARY ALGORITHMS AS PROBLEM SOLVERS (09)
Inheritance: types of inheritance, base class, derived class, usage of final, ambiguity in multiple and multipath Evolutionary algorithms as problem solvers: Simple EAs as Parallel search: representation, reproductive operators, objective fitness evaluation, population sizes and dynamics, convergence and stopping criteria, returning an answer.

MODULE – V: EA-BASED OPTIMIZATION (10)
EA-based optimization: OPT-EAs, Parameter optimization, constrained optimization, data structure optimization, multi-objective optimization. EA based Search, EA based machine learning, EA based automated programming, EA based Adaptation.

V. TEXTBOOKS:

1. De Jong, Kenneth A. Evolutionary Computation: A Unified Approach. India, Prentice-Hall of India Pvt. Limited, 2006.

VI. REFERENCE BOOKS:

1. Michalewicz, Z, and Fogel, D.B. Evolutionary Computation 1: Basic Algorithms and Operators.
2. United States, CRC Press, 2018.
3. Yang, Xin-She. Nature-Inspired Optimization Algorithms. Netherlands, Elsevier Science, 2014.
4. Penny, John, Lindfield, George. Introduction to Nature-Inspired Optimization. United Kingdom, Elsevier Science, 2017.

VII. WEB REFERENCES

1. https://direct.mit.edu/evco/article-abstract/31/4/337/115603/Theoretical-Analyses-of-Multiobjective?redirectedFrom=PDF
2. https://www.youtube.com/watch?v=qY6AO68cSrc&list=PLwdnzlV3ogoWyi7exLIe26JhueiVQXq_S&index=3
3. https://www.youtube.com/watch?v=WueuYdDqUt0
4. https://www.youtube.com/watch?v=pM4WXOMMlpk
5. https://www.youtube.com/watch?v=MR-NaK7XMhM

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)