COURSE CONTENT

EVOLUTIONARY ALGORITHMS APPLICATIONS IN POWER ENGINEERING								
III Semester: EPS								
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
BPSE15	Core	**L**	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
		3	0	0	3	40	60	100
Contact Classes: 45	**Tutorial Classes:**	**Practical Classes:**				**Total Classes: 45**		
Prerequisite: Artificial Intelligence Techniques in Electrical Engineering								

I. **COURSE OVERVIEW:** This course provides a comprehensive overview of modern optimization techniques. It begins with the fundamentals of soft computing and meta-heuristic algorithms. The curriculum then explores key population-based methods like Genetic Algorithms, Particle Swarm Optimization, and other biology-inspired algorithms. Finally, the course covers Multi-Objective Optimization, introducing concepts like Pareto optimality and the NSGA-II algorithm for solving complex, real-world engineering problems.

II. COURSE OBJECTIVES:

The students will try to learn

I. The algorithms like GA, PSO, ANT COLONY and BEE COLONY etc
II. The Evolutionary algorithms to solve power systems problems.
III. The solution of multi-Objective optimization using these algorithms

III. COURSE OUTCOMES:

At the end of the course students should be able to:

CO1 Discriminate the capabilities of bio-inspired system and conventional methods in solving optimization problems.
CO2 Examine the importance of exploration and exploitation of swarm intelligent system to attain near global optimal solution.
CO3 Distinguish the functioning of various swarm intelligent systems
CO4 Employ various bio-inspired algorithms for power systems engineering applications.
CO5 Design and apply multi-objective optimization algorithms, particularly the NSGA-II method

IV. COURSE CONTENT:

MODULE–I: FUNDAMENTALS OF SOFT COMPUTING TECHNIQUES: (9)

Definition, Classification of optimization problems, Unconstrained and constrained optimization optimality condition, Introduction to intelligent systems, Soft computing techniques, Conventional computing versus swarm computing, Classification of meta-heuristic techniques, Single solution based and population based algorithms, Exploitation and exploration in population based algorithms, Properties of Swarm intelligent Systems, Application domain, Discrete and continuous problems, Single objective and multi-objective problems.

MODULE–II: GENETIC ALGORITHM & PARTICLE SWARM OPTIMIZATION: (9)

Genetic algorithms, Genetic algorithm versus Conventional Optimization Techniques, Genetic representations and selection mechanisms: Genetic operators, Different types of crossover and mutation operators, Bird flocking and Fish Schooling-anatomy of a particle, Equations based on velocity and positions, PSO topologies, Control parameters, GA and PSO algorithms for solving ELD problems.

MODULE–III: ANT COLONY OPTIMIZATION & ARTIFICIAL BEE COLONY ALGORITHMS: (9)

Biological ant colony system, Artificial ants and assumptions, Stigmergic communications, Pheromone updating, Local-global-pheromone evaporation, Ant colony system, ACO models, Touring ant colony system, Max min ant system, Concept of elastic ants, Task partitioning in honey bees, Balancing foragers and receivers, Artificial bee colony (ABC) algorithms, Binary ABC algorithms, ACO and ABC algorithms for solving Economic Dispatch of thermal units.

MODULE–IV: SHUFFLED FROG-LEAPING ALGORITHM & BAT OPTIMIZATION ALGORITHM: (9)

Bat algorithm, Echolocation of bats, Behavior of micro bats, Acoustics of echolocation, Movement of Virtual bats, Loudness and pulse Emission, Shuffled frog algorithm, Virtual population of frogs, Comparison of memes and genes, Memeplex formation, Memeplex updation, BA and SFLA algorithms for solving ELD and optimal placement and sizing of the DG problem

MODULE–V: MULTI OBJECTIVE OPTIMIZATION (9)

Multi-Objective optimization introduction, Concept of pareto optimality, non-dominant sorting technique, Pareto fronts, best compromise solution, Min-max method, NSGA-II algorithm and applications to power systems.

V. TEXT BOOKS:

1. Xin-She Yang, “Recent Advances in Swarm Intelligence and Evolutionary Computation”, Springer International Publishing, Switzerland, 2015.
2. Kalyanmoy Deb,” Multi-Objective Optimization using Evolutionary Algorithms”, John Wiley & Sons, 2001.

VI. REFERENCE BOOKS:

1. James Kennedy and Russel E Eberheart, “Swarm Intelligence”, The Morgan Kaufmann Series in Evolutionary Computation, 2001.
2. Eric Bonabeau, Marco Dorigo and Guy Theraulaz, “Swarm Intelligence-From natural to Artificial Systems”, Oxford university Press, 1999.
3. David Goldberg, “Genetic Algorithms in Search, Optimization and Machine Learning”, Pearson Education, 2007.

VII. WEB REFERENCES:

1. http://www.scholarpedia.org/article/Swarm_intelligence
2. https://en.wikipedia.org/wiki/Metaheuristic
3. http://www.cleveralgorithms.com/

VIII. MATERIALS ONLINE

1. Course template
2. Tutorial question bank
3. Tech talk topics
4. Open end experiments
5. Definitions and terminology
6. Assignments
7. Model question paper – I
8. Model question paper – II
9. Lecture notes
10. E-learning readiness videos (ELRV)
11. Power point presentation