Detailed Syllabus

Subject Code	19M12CS211	**Semester odd**	**Semester M.Tech.II sem Session EVEN 2021** **Month from Jan to June**
Subject Name	Nature Inspired Computation and Applications		
Credits	**3**	**Contact Hours**	**3**

Faculty (Names)	**Coordinator(s)**	Dr. Anuja Arora
	Teacher(s) (Alphabetically)	Dr. Anuja Arora

SNO	Description	Cognitive Level (Bloom Taxonomy)
CS211.1	Identify the need of computational complexity, evolutionary, and approximate algorithms.	Apply Level (Level 3)
CS211.2	Understand nature inspired algorithms, its strength, weakness, and suitability	Understand Level (Level 2)
CS211.3	Make use of nature-inspired algorithms to design, learn and optimize problem	Apply Level (Level 3)
CS211.4	Evaluate performance of Nature inspired algorithm in context of problem solving in optimized manner	Evaluate Level (Level 5)
CS211.5	Create a real environment effective artificial system with the use of properties exhibited from nature.	Create Level (Level 6)

Module No.	Subtitle of the Module	Topics in the module	No. of Lectures for the module
1.	Nature Inspired Computation Fundamental	Computational Complexity, NP-Hardness, Reductions, Approximation Algorithms vs. Heuristics, Newton Raphson Method, Characteristics of Natural Systems/Algorithms	3
2.	Empirical and Evolutionary Algorithms	Empirical Algorithms, Empirical hardness. Evolutionary Algorithms, optimization Fitness landscape Analysis, EA Theory	4
3	Evolutionary Algorithms	Genetic Algorithm, GA Encoding Techniques, Selection techniques, Variation(Crossover and Mutation) Techniques, Genetic Programming Differential Evolution Algorithm, sample problems, DE-Crossover and Mutation techniques	8
4	Swarm Intelligence	Particle Swarm Optimization Binary PSO	17

	Algorithm	Ant Colony Optimization Artificial Bee Colony Algorithm, Cuckoo Search Firefly Algorithm BAT Algorithm	
5	Miscellaneous Optimization Algorithm	Gravitational Search Algorithm Teaching Learning Based Optimization Nondominated sorting genetic algorithm II (NSGA-II) Artificial Immune System Self-organizing Maps	8
11	NIC in Real Context	Constraint Handling, Parallelization and vectorization of Fitness Function. Case Studies: World Wide Web, Social Network, Modeling, Image Processing, Earthquake, routing & scheduling	2
		Total number of Lectures	**42**

Evaluation Criteria

Components	Maximum Marks
T1	20
T2	20
End Semester Examination	35
TA	25
	Attendance = 10
	Class Test/Quiz = 10
	Mini-Project = 5
Total	100

Project Based Learning: Students will form a group of 2-3 students. To design a problem statement, students read 4-5 research papers in which nature inspired computational algorithms have been used to handle real scenario problems. Theme and topic of project is chosen based on read research papers. Understanding usage of appropriate optimization technique, then implementation of the selected optimization algorithm and evaluating its effectiveness based on performance measure help students to know the concept of applying the optimization techniques in real life case scenario.

Text Books Books	
1.	Evolutionary Optimization Algorithms, D. Simon (2013), Wiley.
2.	Yang, X. S. (Ed.). (2017). Nature-inspired algorithms and applied optimization (Vol. 744). Springer.

Reference Books	
1.	Eberhart, Russell C., and Yuhui Shi. Computational intelligence: concepts to implementations. Elsevier, 2011
2.	Bio-Inspired Artificial Intelligence: Theories, Methods, and Technologies, D.Floreano and C. Mattiussi

	(2008), MIT Press.
3.	Fundamentals of Natural Computing: Basic Concepts, Algorithms, and Applications, L. N. de Castro (2006), CRC Press.
4.	Leandro Nunes de Castro, " Fundamentals of Natural Computing, Basic Concepts, Algorithms and Applications", Chapman & Hall/ CRC, Taylor and Francis Group, 2007
5.	Marco Dorrigo, Thomas Stutzle," Ant Colony Optimization", PHI,2005
6.	Albert Y.Zomaya, "Handbook of Nature-Inspired and Innovative Computing", Springer, 2006
7.	Coello, C. C., Dhaenens, C., & Jourdan, L. (Eds.). (2009). Advances in multi-objective nature inspired computing (Vol. 272). Springer.