SEMESTER S6

HEURISTICS SOLUTION TECHNIQUES

Course Code	OEIET614	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:0:0:0	ESE Marks	60
Credits	3	Exam Hours	2 Hrs. 30 Min.
Prerequisites (if any)	None	Course Type	Theory

Course Objectives:

1. To provide basic understanding of various meta-heuristic solution algorithms.
2. To enable students to apply heuristic algorithms for solving optimization problems.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	**Basic concepts & Evolutionary algorithms:** Genetic algorithm (GA), basic concepts, types of encoding, selection, crossover and mutation, binary, continuous, hybrid and parallel GA, application of GA in solving constrained and combinatorial optimization problems, sequencing and scheduling problems and transportation problems.	8
2	**Ant Colony Algorithms:** Overview, basic algorithm, variants, formalization and properties of ant colony optimization, applications in scheduling and vehicle routing problem. **Particle Swarm Optimization (PSO)**: Basic concepts, swarm intelligence principles, computational characteristics, parameter selection, discrete PSO, variants and applications.	10
3	**Search based algorithms:** Scatter search - Components, algorithm, applications, greedy randomized adaptive search procedure, Tabu Search (TS) - principles, neighbourhood, candidate list, short - term and long - term memory, threshold accepting, application of TS in decision making. **Simulated Annealing:** Main components of simulated annealing, homogeneous vs. in-homogenous simulated annealing, annealing schedules, applications in sequencing and scheduling, travelling salesman problem, variants of simulated annealing.	10

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4	**Artificial Neural Networks (ANN)**: Basic concepts, biological and artificial neurons, learning rules and activation functions, ANN architecture, single layer and multi layer feed forward networks, back propagation networks and applications. **Fuzzy Systems:** Crisp logic, predicate logic, fuzzy logic, fuzzy rule based system, defuzzification methods, applications.	**8**

Course Assessment Method
(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	**15**	**10**	**10**	**40**

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

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Part A	Part B	Total
• 2 Questions from each module. • Total of 8 Questions, each carrying 3 marks **(8x3 = 24 marks)**	• Each question carries 9 marks. • Two questions will be given from each module, out of which 1 question should be answered. • Each question can have a maximum of 3 subdivisions. **(4x9 = 36 marks)**	**60**

Course Outcomes (COs)

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

Course Outcomes		Bloom's Knowledge Level (KL)
CO1	Apply evolutionary algorithms for decision making.	**K3**
CO2	Solve combinatorial optimization problems using nature inspired algorithms.	**K3**
CO3	Make use of effective searches to arrive at smart solutions to complex decision problems in engineering and management.	**K3**
CO4	Apply artificial neural network and fuzzy logic concepts to solve complex problems.	**K3**

Note*: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create*

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	-	3	3	-	-	2	3	3	-	3
CO2	3	3	-	3	3	-	-	2	3	3	-	3
CO3	3	3	-	3	3	-	-	2	3	3	-	3
CO4	3	3	-	3	3	-	-	2	3	3	-	3

Note: *1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation*

Text Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Modern Heuristic Techniques for Combinatorial Problems	Colin R. Reeves	Orient Black Swan	1st Edition, 1993
2	Metaheuristics for Hard Optimization	Johann Dréo, Alain Pétrowski, Patrick Siarry, Eric Taillard	Springer-Verlag Berlin and Heidelberg Gmbh	1st Edition, 2010

Reference Books				
Sl. No	**Title of the Book**	**Name of the Author/s**	**Name of the Publisher**	**Edition and Year**
1	Metaheuristic Search Concepts-A Tutorial with Applications to Production and Logistics	Günther Zäpfel , Roland Braune, Michael Bögl	Springer-Verlag Berlin and Heidelberg GmbhGmbh	20th Edition, 2014
2	Meta-Heuristics: Theory and Applications	Ibrahim H. Osman, James P. Kelly	Springer	1st Edition, 1996
3	Meta-Heuristics: Advances and Trends in Local Search Paradigms for optimization	Stefan Voß, Silvano Martello, Ibrahim H. Osman, Cathérine Roucairol	Springer	1st Edition, 1998
4	Genetic Algorithms + Data Structures = Evolution Programs	Z. Michalewicz	Springer-Verlag Berlin and Heidelberg Gmbh	2nd Edition, 1994

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Video Links (NPTEL, SWAYAM…)	
Link ID	https://archive.nptel.ac.in/courses/106/106/106106226/
	https://archive.nptel.ac.in/courses/110/106/110106134/