Course No.	Course Name	L-T-P-Credits	Year of Introduction
CS365	OPTIMIZATION TECHNIQUES	3-0-0-3	2015

Course Objectives

1. *To build an understanding on the basics of optimization techniques.*
2. *To introduce basics of linear programming and meta- heuristic search techniques.*

Syllabus

Basics of Operations Research - Formulation of optimization problems - Linear Programming - Transportation Problem - Assignment Problem - Network flow Problem - Tabu Search - Genetic Algorithm - Simulated Annealing – Applications.

Expected Outcome

Student is able to

1. *Formulate mathematical models for optimization problems.*
2. *Analyze the complexity of solutions to an optimization problem.*
3. *Design programs using meta-heuristic search concepts to solve optimization problems.*
4. *Develop hybrid models to solve an optimization problem.*

Text Books

1. Rao S.S., Optimization Theory and Applications, Wiley Eastern.
2. Hamdy A. Taha, Operations Research – An introduction, Prentice – Hall India.
3. G. Zapfel, R. Barune and M. Bogl, Meta heuristic search concepts: A tutorial with applications to production and logistics, Springer.

References

1. Gass S. I., Introduction to Linear Programming, Tata McGraw Hill.
2. Reeves C., Modern heuristic techniques for combinatorial problems, Orient Longman.
3. Goldberg, Genetic algorithms in Search, optimization and Machine Learning, Addison Wesley.
4. K. Deb, Optimization for engineering design – algorithms and examples, Prentice Hall of India.

COURSE PLAN			
Module	**Contents**	**Hours**	**Sem. Exam Marks %**
I	Decision-making procedure under certainty and under uncertainty - Operations Research-Probability and decision- making- Queuing or Waiting line theory-Simulation and Monte- Carlo Technique-Nature and organization of optimization problems-Scope and hierarchy of optimization- Typical applications of optimization.	08	15%
II	Essential features of optimization problems - Objective function- Continuous functions - Discrete functions - Unimodal functions - Convex and concave functions, Investment costs and operating costs in objective function - Optimizing profitably constraints-Internal and external constraints-Formulation of optimization problems. Continuous functions - Discrete functions - Unimodal functions - Convex and concave functions.	07	15%
FIRST INTERNAL EXAM			
III	Necessary and sufficient conditions for optimum of unconstrained functions-Numerical methods for unconstrained functions - One-dimensional search - Gradient-free search with fixed step size. Linear Programming - Basic concepts of linear programming - Graphical interpretation-Simplex method - Apparent difficulties in the Simplex method.	06	15%
IV	Transportation Problem, Loops in transportation table, Methods of finding initial basic feasible solution, Tests for optimality. Assignment Problem, Mathematical form of assignment problem, methods	06	15%

	of solution.		
SECOND INTERNAL EXAM			
V	Network analysis by linear programming and shortest route, maximal flow problem. Introduction to Non-traditional optimization, Computational Complexity – NP-Hard, NP-Complete. Tabu Search- Basic Tabu search, Neighborhood, Candidate list, Short term and Long term memory	07	20%
VI	Genetic Algorithms- Basic concepts, Encoding, Selection, Crossover, Mutation. Simulated Annealing - Acceptance probability, Cooling, Neighborhoods, Cost function. Application of GA and Simulated Annealing in solving sequencing and scheduling problems and Travelling salesman problem.	08	20%
END SEMESTER EXAM			

Question Paper Pattern

1. There will be *five* parts in the question paper – A, B, C, D, E
2. Part A
   a. Total marks : 12
   b. *Four* questions each having 3 marks, uniformly covering modules I and II; All*four* questions have to be answered.
3. Part B
   a. Total marks : 18
   b. *Three*questions each having 9 marks, uniformly covering modules I and II; *Two* questions have to be answered. Each question can have a maximum of three subparts.
4. Part C
   a. Total marks : 12
   b. *Four* questions each having 3 marks, uniformly covering modules III and IV; All*four* questions have to be answered.

5. Part D
    a. Total marks : 18
    b. *Three*questions each having *9* marks, uniformly covering modules III and IV; *Two* questions have to be answered. Each question can have a maximum of three subparts
6. Part E
    a. Total Marks: 40
    b. *Six* questions each carrying 10 marks, uniformly covering modules V and VI; *four* questions have to be answered.
    c. A question can have a maximum of three sub-parts.

7. There should be at least 60% analytical/numerical questions.