Department Of Computer Science and Engineering
Kathmandu University
Dhulikhel, Kavre

Subject: Computational Operations Research **Course: COMP 317**

Level: B.Sc 3rd Year/1st Semester **Credit Hours: 4**

Computational Operations Research (COR) practitioners model real world systems and analyze their behavior using a variety of mathematical and computational techniques. Although the term" Operations Research" stems from a study of military operations conducted during World War II, the scope of COR today encompasses a variety of problems in business, engineering, economics, social and physical sciences , airline crew scheduling ,actuator placement in flexible space structures, efficient image reconstruction, allocation of spare parts, job shop scheduling, reliability and performance analysis.

Objective:

This course aims at familiarizing the students with computational tools and techniques in the various optimization methods which are frequently applied to decision-making process & to provide a formal quantitative approach to problem solving and an intuition about situations where such an approach is appropriate.

The curriculum in Computational Operations Research (COR) is designed to emphasize:

- Applications to real-world problem
- Computational experiences with both handy solving the problem and specialized software.
- Mathematical modeling and formulations
- Optimization technique and theory
- Simulation technique and theory
- Theory of queue and their applications and their simulation
- Network analysis by using PERT and CPM.

At the same time, the curriculum strives to be flexible after core competencies in the area are met. The unit wise outline of the course is given below:

Unit 0: A review of Matrix Algebra [3]

Vectors: Euclidean n-Space, Vector inequalities, Linear Combinations of vectors, Basis, Standard Basis, Replacement Theorem, Hyper-planes and Half-spaces ,Convex set and Convex hull; Matrices: Inverse of a Matrix,

Unit1: Linear Programming [11]

Introduction, Historical Background, Application of Linear Programming, Requirements and Assumption of a Linear Programming. Formulation technique of LP problems. Graphical Solution of two variable problems. Standard form of LP problem. Matrix form of LP problems. Computational Procedure for simplex method, artificial variable technique- Big M- method. , Two phases Simplex Method. Unbounded solutions. Non-existing feasible solutions. Definition of the dual problem, General rules for converting any Primal into its Dual. Fundamental Theorem of Linear Programming, Minimax Theorem. How to read the solution of the Dual from the final simplex table of the Primal and conversely. Dual Simplex Method.

Use of available software (TORA and Lindo 6.1):[2]

- **(i) Graphical Solution of LP-problems**
- **(ii) Solution of LP-problem by Simplex-Method by using Big-M and two-Phase technique**
- **(iii) Interpretation of solution in terms of dual price and reduced cost**

Unit2: Integer Programming [3]

Introduction, Mathematical Formulation of the problem, The graphical Method of solution, The Gomory Approach, The Branch and Bound Method.

Use of available software (TORA and Lindo 6.1):[1]

- **(i) Solution of LP-problem for its integer value by using TORA under** Branch and Bound techniques

Unit3: Transportation Models [8]

Introduction. Mathematical formulation, Tabular representation. Method for initial basic feasible solution, Optimality test, Transportation algorithm for minimization.
Computation demonstration of optimality test. Degeneracy in Transportation problems.

Use of available software (TORA and Lindo 6.1):[2]

- **(i) Finding the minimum cost of transportation problems**
- **(ii) Finding the route that minimize the cost of transportation**

Unit4: Assignment Model [8]

Introduction. Mathematical formulation of the Assignment problem. Theorem (without proofs). Methods for solving Assignment problems. Assignment solution procedure (Hungarian Assignment methods). Unbalanced Assignment problem. The traveling salesman problem and its formulation. Solution procedure.

Use of available software (TORA and Lindo 6.1):[2]

- **(i) Finding the minimum cost of Assignment problems by using TORA.**
- **(ii) Finding the routes that minimize the cost of assignments by using TORA.**

Unit5: Simulation (Monte-Carlo Technique)[4]

Introduction. Definitions of Simulation. Types of Simulation. Why to use simulation. Generator of Random numbers, Monte –Carlo simulation. Applications of simulation techniques of various problems.

Unit 6: Queuing Models [6]

Introduction. General description of Queue. Characteristic to be studied. Kendall's notation for representation, Queuing models. Classification of Queuing models, Solution of queuing models.

Use of available software (TORA and Lindo 6.1):[1]

- **(i) Finding the waiting number of customers in the queue**
- **(ii) Finding the number of customers in the system**
- **(iii) Finding waiting time and system time in the queue and system.**

Unit7: Network Planning [9]

Introduction. Project scheduling. The planning stage-Definition of activities. Graphical representation of events and activities. The analysis stage-The critical path. Technique for finding the critical path(s). Activity float time. Tabular representation of results. Scheduling the projects, PERT and activity time Estimates.

Use of available software (TORA and Lindo 6.1):[1]

- **(i) Changing the network problem into LP-problems and solve those by LINDO 6.1**

Textbooks:

1. Essentials of Linear programming, Dr. Jit S. Chandan, Dr. Mahendra P. Kawatra, Dr. Ki Ho Kim, Vikas publishing House Pvt. Ltd., 1994
2. Linear programming and Theory of Games, P.K.Gupta, Man Mohan, Sultan Chand & Sons, 1993.

Reference Book:

1. G.Hadley ,Linear programming, Narosa publishing House Pvt. Ltd., 1990
2. Dr. S.D.Sharma, Operation Research, 1991-1992, Kedar Ram Nath and company, Meerut, India.

3. P.K. Gupta, Manmohan, Linear Programming and theory of games, 1991, Sultan Chand and Sons.
4. Prem kumar Gupta and Dr. D.S.Hira, Operations Research,Revised edition 2008.
5. H.A., Taha, Operations Research: an Introduction, Macmillan, New York.
6. J.K., Sharma :Operations Research: Theory and Applications, Macmillan India, New Delhi