# GUJARAT TECHNOLOGICAL UNIVERSITY

## INFORMATION AND COMMUNICATION TECHNOLOGY
OPERATION RESEARCH
**SUBJECT CODE:** 2163201
B.E. 6<sup>th</sup>SEMESTER

**Type of course:** Operation Research

**Prerequisite:** Knowledge of models used for management like Transportation, Assignment, linear programming.

**Rationale:** This course provides strong foundation for understanding the fundamental principles and laws of Operation Research to understand Linear programming, network Analysis and queuing, replacement models. Students can understand and solve the problems regarding management and application of various models .

**Teaching and Examination Scheme:**

| Teaching Scheme | | | Credits | Examination Marks | | | | | | Total Marks |
|---|---|---|---|---|---|---|---|---|---|---|
| L | T | P | C | Theory Marks | | | Practical Marks | | | |
| | | | | ESE (E) | PA (M) | | ESE (V) | | PA (I) | |
| | | | | | PA | ALA | ESE | OEP | | |
| 4 | 0 | 2 | 6 | 70 | 20 | 10 | 20 | 10 | 20 | 150 |

**Content:**

| Sr. No. | Content | Total Hrs. | % Weightage |
|---|---|---|---|
| 1 | **Introduction to OR :** Concepts, genesis, Art of modeling, components of model, Types of OR models, effect of data availability on modeling, Computations in OR, Phases of OR study. | 04 | 05 |
| 2 | **Linear Programming (LP) :** Concepts, Formulation of model, Graphical solution, Maximisation / Minimisation – Simplex Algorithm, Use of slack / surplus / artificial variables, Big M and Two phase method – Nature & type of solutions, Interpretation of optimal solution. Dual problem – relation between primal and dual , Dual simplex method – Interpretation of dual variables, Introduction to Integer programming, Developing software for LP solution methods and exposure to available LP & IP Packages. | 15 | 15 |
| 3 | **Transportation & Assignment problems:** Concepts, formulations of models, Solution procedures, Optimality checks, Balanced/Unbalanced, Maximum/Minimum problems, Prohibited case – degeneracy | 06 | 10 |
| 4 | **Network Analysis:** Network Definition, Minimal spanning tree problem, Shortest route problem, Maximal flow problem concepts and solution algorithm as applied to problems. Project planning and control by CPM network, Probability assessment in PERT network. | 06 | 10 |
| 5 | **Introduction to resource smoothing and allocation:** Development of software for the techniques and exposure to Project Management Packages. | 03 | 05 |
| 6 | **Queuing Models:** Concepts relating to Queuing systems, types of queuing system (use of six character code), Basic elements of Queuing | 09 | 10 |

| | | | |
|---|---|---|---|
| | Model, Role of Poison & Exponential Distribution, Concepts of Birth and Death process, Steady state measures of performance, M/M/1 model with and without limitation of q-size M/G/1, single channel with poisson arrival rate and general service time. | | |
| 7 | **Computer Modelling & Simulation:** Use of Computer in modelling real life situations, Distribution functions, Random number generation, Selection of input probability distribution, Design of simulation models Experimental design, output analysis variance reduction techniques. Introduction to simulation languages Programming tools for developing simulation models. | 04 | 05 |
| 8 | **Replacement & Maintenance Models :** Replacement of items, subject to deterioration of items subject to random failure Group Vs. Individual replacement policies. | 05 | 10 |

**Suggested Specification table with Marks (Theory):**

| Distribution of Theory Marks | | | | | |
|---|---|---|---|---|---|
| R Level | U Level | A Level | N Level | E Level | C Level |
| **05** | **20** | **10** | **20** | **10** | **05** |

**Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom's Taxonomy)**

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

**Text Books:**
1. Quantitative Techniques in management, N.D. Vora – Tata McGraw Hill
2. Operations Research – An Introduction – Fifth edition by Hamdy A Taha- Prentice Hall of India , New Delhi.
3. Principles of Operations Research : With Applications to Management Decisions, Wagner, H.M. , Prentice-Hall of India, New Delhi, 1982.
4. Hillier, F.S. and Lieberman, G.J., Operations Research, Holden Day Inc., San Francisco, 1974.
5. Littlechild, S.C. (ed), Operational Research for Managers, Philip Allan, Oxford, 1977.
6. Mitchell, G.H. (ed), Operational Research Techniques and examples, The English Universities Press Ltd., London, 1972. Moder, J.J. and Elmaghraby, S.E. (ed.), Handbook of Operations Research: Models and Applications, Van Nostrand Reinhold Co., New York, 1987.
7. Payne, T. A., Quantitative Techniques for Management: A Practical Approach, Reston Publishing Co.Inc., Virginia, 1982. Wilkes, F.M., Baum, P. and Smith, G.D., Management Science: An introduction, John Wiley and Sons, Santa Barbara, 1979.

**Course Outcome:**
After learning the course the students should be able to:

1. Introduction to Operation Research
2. Exercise on formulation of LP problems
3. Exercise on graphical solution of LP problems
4. Exercise on Simplex method
5. Exercise on Two-Phase method
6. Exercise on duality of LP problems
7. Exercise on Transportation problems
8. Exercise on Assignment problems
9. Exercise on Queuing problems
10. Exercise on Replacement problems

11. Study about Simulation of a Forward Pass Mechanism used for finding Critical path in a PERT analysis
12. Simulation of a Single Server Queuing Model.
13. Simulation of a Double Server Queuing Model.

**List of Experiments:** Assignments from different chapters to be given to students. Numerical to be solved from each chapter in tutorial class.

**Design based Problems (DP)/Open Ended Problem:**
1. Exercise on Game Theory
2. Study of Dynamic Programming problems.
3. Implementation of Simplex
4. Minimum spanning tree algorithm

**List of Open Source Software/learning website:**
1. http://nptel.iitm.ac.in/courses.php?disciplineId=112
2. http://www.sciencedirect.com
3. http://ieeexplore.ieee.org
4. Programming Languages: C, MATLAB.

**ACTIVE LEARNING ASSIGNMENTS**: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.