

# GUJARAT TECHNOLOGICAL UNIVERSITY

## MECHANICAL (INDUSTRIAL ENGINEERING) (46)

ADVANCE OPERATIONS RESEARCH

SUBJECT CODE: 2744602

M.E. 4<sup>TH</sup> SEMESTER

**Type of course:** Major Elective - V

**Prerequisite:** Nil

**Rationale:** The aim of this course is to make students aware of various operations research techniques and how to use the same to solve industrial problems.

### Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P		Theory Marks		Practical Marks				
			ESE (E)	PA (M)	ESE (V)		PA (I)			
				ESE	OEP	PA	RP			
3	0	2#	4	70	30	30	0	10	10	150

### Content:

Sr. No.	Content	Total Hrs	% Weightage
1	<b>General concepts:</b> History, Definition, OR Models, OR Techniques and phases of implementing OR in practice	02	05
2	<b>Linear Programming Model:</b> Assumption, Limitations, Formulation of mathematical models, Solution of linear programming problems involving product mix, resource allocation, transportation and assignment by graphical, simplex and dual simplex methods, Duality theorem and applications and Sensitivity analysis	08	18
3	<b>Transportation Problems:</b> General Concepts, Formulation of TT problems and LP formulation of TT Problems, Solution Methods: North West Corner Method, Least Cost Method, Vogels Approximation Method, Optimality Tests: Stepping Stone Method and Modified Distribution method, Balanced/Unbalanced transportation problem, Degeneracy	04	10
4	<b>Assignment Problems:</b> General Concepts, Assumptions & Limitations, Formulation and solution of assignment problem, Special Issues: Restricted routes/Multiple Optimal Solutions.	04	09
5	<b>Network Analysis:</b> Introduction to Network, Minimum spanning tree algorithm, Shortest path problem, Maximal flow problem.	04	08
6	<b>Project Management:</b> Introduction, Definitions, Terminology, Assumptions, Limitations, Applications of Networks, Types of Networks: Critical Path Method and Programme Evaluation Review Technique, Estimation of Project	04	10

	completion time, Project Cost Analysis: Crashing, Project cost time trade-off, Resource allocation techniques		
7	<b>Queuing Model</b> Queuing theory notation and assumptions, Poisson's queuing models.	03	07
8	<b>Games theory:</b> Introduction, Two-person zero-sum games, The Maximin -Minimax principle, Games without saddle points - Mixed Strategies, 2xn and mx2 Games -Dominance property, Algebraic solutions to rectangular games. Graphical solution.	04	09
9	<b>Integer programming:</b> Graphical representation. Gomory's cutting plane method, Branch-and-bound method, Travelling salesman problem, Cargo loading problem.	04	08
10	<b>Non linear programming: Single variable optimization</b> Introduction, Kuhn-Tucker conditions, Quadratic programming, Separable programming.	03	07
11	<b>Special topics:</b> Analytic Hierarchy Process for Decision Making, Extreme Difference Method, Generalized Transportation Problem, Generalized Assignment Problem, Multi-objective Transportation Problem.	05	09
	<b>Total</b>	<b>45</b>	<b>100</b>

#### Reference Books:

1. Wagner H. M., Principles of Operation Research with Applications to Managerial Decisions, 2nd Ed., PHI, 2010.
2. Taha H. A., Operation Research, 7th Ed., *Prentice Hall of India*, New Delhi, 2002.
3. Vohra N.D, Quantitative Techniques in Management, Tata McGraw Hill, 1995.
4. Sharma J. K., Operation Research Theory and Applications, 2nd Ed., Macmillan, 2003.
5. Hira D. S. &Gupt P. K., Operations Research, S. Chand & Co. 1995.
6. Kasana H. S., Kumar K. D., Introductory Operations Research Theory and Applications, Springer, 2003.
7. Wilkes F. M., Elements of Operational Research, McGraw Hill Co.
8. Levin R. et.al, Quantitative approaches to mgmt, McGraw Hill Co.
9. Hiller & Lieberman, Introduction to Operations Research
10. Richard Bronson, Govindasamy&Naachimuthu, Schaum's Outline of Theory and Problems of Operations Research, II Edition, Tata McGraw Hill , 2004.
11. en R. P., Operations Research Algorithm and Applications, PHI, New Delhi.
12. Shah N. H., Gor R. M., Soni H., Operations Research, PHI, New Delhi, 2007.

#### Course Outcome:

After learning the course the students should be able to:

1. Understand the concepts and importance of operation research techniques in real life.
2. Understand the process of optimization in different areas of manufacturing and services.
3. Know how to formulate real life industrial problems in to mathematical model.
4. They should be able to identify the problems and be able to categories and solve it by different methods i.e. LP technique, Transportation model, assignment model, queuing model, game theory model etc.
5. Understand the concept of project management for optimizing the project cost.

**List of Tutorials:**

1. Linear Programming Model (Formulation/Graphical/Simplex Method)
2. Transportation Model
3. Assignment Model
4. Network Techniques
5. Project Management
6. Queuing Model
7. Game theory Model
8. Integer Programming

**List of Open Source Software/learning website:** TORA and LINDO software

**Review Presentation (RP):** The concerned faculty member shall provide the list of peer reviewed Journals and Tier-I and Tier-II Conferences relating to the subject (or relating to the area of thesis for seminar) to the students in the beginning of the semester. The same list will be uploaded on GTU website during the first two weeks of the start of the semester. Every student or a group of students shall critically study 2 papers, integrate the details and make presentation in the last two weeks of the semester. The GTU marks entry portal will allow entry of marks only after uploading of the best 3 presentations. A unique id number will be generated only after uploading the presentations. Thereafter the entry of marks will be allowed. The best 3 presentations of each college will be uploaded on GTU website.