



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Master of Engineering

Level: PG

Subject Code: ME03000121

Course/Subject Name: Operational Research

w. e. f. Academic Year:	2024 - 25
Semester:	3
Category of the Course:	MOPEC

Prerequisite:	Nil
Rationale:	The course covers "Operations Research and its tools with applications". It is a scientific approach to problem solving for decision making which requires the formulation of models and for decision and control problems to deal the situations arising out of risk and uncertainty. Operation research techniques are useful for solving real life Industrial problems. Problems can be of Manufacturing, Service and supply related. Different techniques help for optimization of linear as well as non - linear type problem.

PO

No	Program Outcomes
01	Engage in critical thinking and research to develop solutions to multifold real-world problems.
02	Communicate effectively with the engineering community at large level on complex design tasks & write and present technical reports.
03	Demonstrate a high level of professionalism in handling multidisciplinary and complex engineering problems.
04	Plan, assess, create, integrate, carry out, and oversee complex engineering projects in a sustainable local and global context.
05	Address societal issues by offering technologically advanced, reasonably priced solutions while upholding high standards of ethics and professionalism.

Course Outcome:

After Completion of the Course, Student will be able to:

No	Course Outcomes	RBT Level
01	Differentiate various optimization techniques for the transport network.	R, U
02	Formulate and obtain the optimal solution for Linear and Non-linear Programming problems	N, E



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03	Analyze multicriteria optimization for optimality.	N
04	Know how project management techniques help in planning and scheduling a project	A
05	Apply different inventory methods to optimize logistics distribution.	A, N
06	Understand the basics of Decision and Game theory	U

**Revised Bloom's Taxonomy (RBT)*

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
L	T	PR	C	Theory		Tutorial / Practical		
				ESE (E)	PA / CA (M)	PA/CA (I)	ESE (V)	
3	0	0	3	70	30	-	-	100

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	Basics of Optimization: General methods for operation research models; introduction to linear and non-linear programming formulation of different models	2	5
2.	Linear Programming Problems: Properties of Linear Programming Solution, Formulation of a LPP, - graphical solution, simplex method, Big M Method, Dual Simplex method, duality in LPP, sensitivity analysis, Integer linear programming, revised simplex method, parametric linear programming, Dynamic programming under certainty, Dynamic programming approach for solving LPP	10	25
3.	Project Management and Inventory Control: CPM, PERT, Crashing of Project Network, Project Scheduling with Constrained Resources, Models of Inventory, Operation of Inventory system, Purchase Inventory model, Multiple-item Model with Shortage limitation, EOQ Model for Purchase Model for Multi-item Joint Replenishment.	6	20
4.	Decision and Game Theory: Decision under Certainty, Decision under Risk, Decision under Uncertainty, Decision Tree, Theory of games, Game with Pure Strategies, Game with Mixed Strategies, Saddle point, Dominance Property.	7	10
5.	Classical Optimization Methods: Single variable optimization,	7	10



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	Constrained and unconstrained multi-variable optimization, Direct substitution method, Lagrange’s method of multipliers, Kuhn Tucker conditions		
6.	Non-linear Programming: Constrained Optimization Techniques Unimodal function, Unrestricted search, Exhaustive search, Dichotomous search, Interval halving method, Fibonacci method, Golden section method Unconstrained Optimization Techniques Direct Search Methods: Random search methods, Grid search method, Univariate method, Constrained Optimization Techniques Direct Methods: Random search method, Sequential linear programming.	10	25
7.	Evolutionary Algorithms An overview of evolutionary algorithms, Simulated annealing algorithm, Genetic algorithm, Particle swarm optimization	3	5
Total		45	100

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (in %)					
R Level	U Level	A Level	N Level	E Level	C Level
30	20	20	20	10	--

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom’s Taxonomy)

(a) Books:

References/Suggested Learning Resources:

1. Engineering Optimization Theory and Practice, Rao, S.S., Wiley Publisher, 2019, Fifth Edition.
2. Sustainable Logistics and Transportation: Optimization Models and Algorithms, Cinar, D., Gakis, K., Pardalos, P.M., Springer, 2017, First Edition.
3. Introduction to Optimum Design, Arora, J.S., McGraw Hill International Editions, 2016, Fourth Edition
4. Mathematical Methods on Optimization in Transportation Systems, Pursula, M., Niittymäki, J., Springer; 2001, First Edition.
5. J. K. Sharma, Operation Research, Theory and Application, Macmillan Publishers India Ltd, 2013
6. H.A. Taha, Operations Research, An Introduction, PHI, 2008
7. S.S.Rao, Engineering Optimization Theory and Practice, New Age International (P) Ltd, Publishers.
8. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982
9. Pannerselvam, Operations Research: Prentice Hall of India 2010 6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010
10. W. Winston, Operations Research, Duxbury Press. Operations Research: Applications and Algorithms, Wayne L Winston, Indian University, 7th edition, 2014.
11. Frederick S. Hiller, Gerald J. Lieberman, Introduction to Operations Research (Ninth



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Edition)(English), Mc-Graw Hill 2010

12. Operations Research, (4th edition) A.M .Natarajan, P. Balasubramani, ATamilarasi, Pearson Education, New Delhi, 2009
13. Particle Swarm Optimization, Maurice Clerc, Wiley-ISTE; First Edition, 2006
14. Genetic Algorithms in search, Optimization and Machine Learning, David E. Goldberg, Addison-Wesley Publication Co. Ltd., 1st edition, 1989

(b) List of Open-source software: (May not be open source but useful for the subject):

GNU Linear Programming Kit (GLPK), MATLAB, Odoo, LP Solver, Excel

(c) List of MOOC Course link :

<https://nptel.ac.in/courses/112/106/112106134/#>

<https://nptel.ac.in/courses/110104125>

<https://nptel.ac.in/courses/111107128>

(d) List of Experiments/Tutorials:

Minimum 20 problems from above topics, out of which half of the problems shall be also solved using self-developed computer programs in any language.

Assignment work on

- Formulation of mathematical models from the given data
- LP Problems – Graphical method, Simplex method, Big-M method, Dual simplex method
- Dynamic programming
- Network analysis – CPM, PERT, Crashing, Inventory models
- Decision and Game theory
- Classical optimization methods
- Non-linear programming methods
- Simulated annealing algorithm, Genetic algorithm, Particle swarm optimization

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