2-Year Master's Program in Mathematics (NEP-2020)
OPERATIONS RESEARCH

Master's Mathematics (2nd Semester) Total Credits: 04
Course Code: MMTHDOR226 (15 hours per credit) Total Marks: 100
Continuous Assessment: Marks 30, Theory: Marks 70 Time Duration: 2½ hrs

Course Learning Outcomes(CLO's): Upon successful completion of the this course, students will be able to:

CLO1. Formulate and solve linear programming problems using techniques such as the graphical method and the Simplex method.

CLO2. Analyze transportation, assignment, and network flow problems and apply suitable algorithms to find optimal solutions.

CLO3. Apply queueing theory to model and solve real-life problems related to service systems, telecommunications, and manufacturing.

CLO4. Design and implement simulations for optimization, forecasting, and decision-making scenarios. Evaluate and interpret the results of Operations Research models to aid in strategic business, manufacturing, and logistical decisions.

UNIT –I

Operation research: An overview, Linear Programming Problems (LPP): Convex sets and convex functions, Graphical method, Simplex method, Big-M method, Two - phase methods and Revised simplex method, Extreme Point Theorem, Fundamental Theorem of Linear Programming.

UNIT -II

Concept and applications of duality, Primal- Dual relations, Formulation of Dual problem, Duality theorems (weak duality and Strong duality theorems), Complementary slackness theorems and conditions, Dual simplex method. Existence of solution in Transportation Problem (TP), Methods for solving (TP) :, North-West Corner rule, Least Cost Method, Vogel's method and MODI method, Assignment problem: Hungarian method.

UNIT –III

Sensitivity Analysis: Changes in the coefficients of the objective function and Right hand side constants of constraints, Adding a new constraint and a new variable, Network Routing Problem: Dijkstra's Algorithm, Network Scheduling: Rules of Network Construction, PERT and CPM, Probability Consideration in PERT, Distinction between PERT and CPM,

UNIT –IV

Game Theory: Two Person Zero-Sum Games, Games with Pure strategies, Games with Mixed strategies, Maximin - Minimax Principle, Dominance Property, Finding solution of 2x2, 2xm, mx2 games. Equivalence between game theory and linear programming problem (LPP), Simplex method for game problem. Queuing Theory and Simulation, Basic concepts, models (M/M/1, M/M/c, etc.), Little's Law. Queuing Applications: In telecommunications, service systems, and manufacturing. Simulation: Introduction to Monte Carlo simulation, types of simulation, and applications in decision-making.

CLO-PLO Mapping Matrix (Strength version)

CLO ↓ PLO →	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	Average CLO
MMTHDOR226.1	3	3	3	2	3	3	2	2	**2.63**
MMTHDOR226.2	3	3	2	2	2	3	2	3	**2.5**
MMTHDOR226.3	3	3	2	2	1	3	2	3	**2.38**
MMTHDOR226.4	3	3	2	2	1	3	3	3	**2.5**
Average PLO	**3**	**3**	**2.25**	**2**	**1.75**	**3**	**2.25**	**2.75**	**2.5**

Recommended Books:

1. Kanti Swarup, P. K. Gupta, & M. M. Singh, Operation Research. Sultan Chand & Sons, 20th Edition, 2010.
2. Taha, H.A., Operations Research: An Introduction, Pearson, 10th Edition, 2017
3. Hillier, F.S., & Lieberman, G.J. Introduction to Operations Research, McGraw-Hill Education, 10th Edition, 2014.
4. Vanderbei, R.J. Linear Programming: Foundations and Extensions, Springer, 4th Edition, 2014.
5. Gross, D., & Harris, C.M. Fundamentals of Queueing Theory, Wiley, 4th Edition, 2008.