# MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL
*(A constituent unit of MAHE, Manipal)*

## COURSE PLAN

| | | | | |
|---|---|---|---|---|
| **Department :** | **Humanities and Management** | | | |
| **Course Name & code :** | **Operations Research** | | **HUM 3121** | |
| **Semester & branch :** | **V Semester BTech** | **Data Science and Engineering** | | |
| **Name of the faculty :** | **Dr. Rajesh R Pai and Dr. Mahesh Prabhu** | | | |
| **No of contact hours/week: 03** | **L** | **T** | **P** | **C** |
| | **3** | **0** | **0** | **3** |

## COURSE OUTCOMES (COS)

| At the end of this course, the student should be able to: | | No. of Contact Hours | Marks | Program Outcomes (POs) | PSO | BL (Recommended) |
|---|---|---|---|---|---|---|
| **CO1** | Describe the basic assumptions, terminology, general structure, and applications of LP models, and queuing models and formulate the verbal statement of the decision model into a mathematical model. | 6 | 20 | PO1, PO2 | | BL1/BL2 |
| **CO2** | Solve the LP problems using graphical/simplex/assignment and transportation algorithms. | 20 | 60 | PO2, PO3 | | BL2/BL3 |
| **CO3** | Interpret the results obtained and conduct sensitivity analysis. | 4 | 10 | PO3, PO4 | | BL4/BL5 |
| **CO4** | Describe the operating characteristics of queuing models in general and evaluate the system with known and unknown costs in respect of single channel-single phase/multi channel-single phase using either analytical or simulation methods. | 6 | 10 | PO1, PO2, PO3, PO4 | | BL3 |
| | **Total** | **36** | **100** | | | |

## COURSE LEARNING OUTCOMES (CLOS)

| At the end of this course, the student should be able to: | | No. of Contact Hours | Marks | Program Outcomes(POs) | Learning Outcomes (LOs) | BL (Recommended) |
|---|---|---|---|---|---|---|
| **CLO1** | Describe the basic assumptions, terminology, general structure, and applications of LP models, and queuing models and formulate the verbal statement of the decision | 6 | 15 | PO1, PO2 | **C1, C2** | BL1/BL2 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | model into a mathematical model. | | | | | |
| **CLO2** | Solve the LP problems using graphical/simplex/assignment and transportation algorithms. | 20 | 60 | PO2, PO3 | **C3** | BL2/BL3 |
| **CLO3** | Interpret the results obtained and conduct sensitivity analysis. | 4 | 15 | PO3, PO4 | **C3** | BL4/BL5 |
| **CLO4** | Describe the operating characteristics of queuing models in general and evaluate the system with known and unknown costs in respect of single channel-single phase/multi channel-single phase using either analytical or simulation methods. | 6 | 10 | PO1, PO2, PO3, PO4 | **C1, C2, C3** | BL3 |
| | **Total** | **36** | **100** | | | |

## Assessment Plan

| S. No. | Assessment Mode | | Assessment Method | Time Duration | Marks | Weightage | Typology of Questions (Recommended) | Schedule | **Topics Covered |
|---|---|---|---|---|---|---|---|---|---|
| ***IN – SEMESTER ASSESSMENTS*** | | | | | | | | | |
| 1 | IA | 1 | | | 5 | | Bloom's taxonomy (BT) level of the question should be L3 and above. | As per the schedule communicated by the Academic Section | LPP- Formulation, Graphical solution, Simplex Algorithm and Sensitivity Analysis |
| | | 2 | | | 5 | | Bloom's taxonomy (BT) level of the question should be L3 and above. | As per the schedule communicated by the Academic Section | Transportation Algorithm- Generation of Basic Feasible Solution and Testing for Optimality. Checking for Degeneracy, Calculation of Dual Values. |
| | | 3 | **In-Semester Examination** | | 30 | **Objective:** 5M<br>10 MCQs × ½ = 5 marks<br>Descriptive 25 marks. Marks distribution of the descriptive type questions will be as per the template provided by the Academic Section. | Bloom's taxonomy (BT) level of the question should be L3 and above. | As per the schedule communicated by the Academic Section | LPP, Transportation Algorithm and Assignment Algorithm |
| | | 4 | | | 5 | | Bloom's taxonomy (BT) level of the question should be L3 and above. | As per the schedule communicated by the Academic Section | Assignment Algorithm and Queuing theory |
| | | 5 | | | 5 | | Bloom's taxonomy (BT) level of the question should be L3 and above. | As per the schedule communicated by the Academic Section | Comprehensive assessment of all the concepts |
| ***END – SEMESTER ASSESSMENT*** | | | | | | | | | |
| 1 | **Regular/Make–Up Exam** | | | 180 Mins | 50 | Answer all 5 full questions of 10 marks each. Each question can have 3 parts of 2/3/4/5/6 marks. | Bloom's taxonomy (BT) level of the question should be L3 and above. | 17th week of the semester | Comprehensive examination covering full syllabus. |

## LESSON PLAN

| L No | TOPICS | Course Outcome Addressed |
|---|---|---|
| 1 | Introduction to the Operations Research | CO1 |
| 2 | Introduction, Definition, and Phases of OR | CO1 |
| 3 | Linear Programming Problems (LPP)- Introduction, Assumptions in LPP | CO1 |
| 4 | Formulation of LPP for different applications | CO1 |
| 5 | Formulation of LPP for different applications | CO1 |
| 6 | Graphical solution to LPP | CO2 |
| 7 | Graphical solution to LPP | CO2 |
| 8 | Introduction to Simplex Algorithm | CO2 |
| 9 | Maximization case | CO2 |
| 10 | Minimization case | CO2 |
| 11 | Equality constraints | CO2 |
| 12 | Special cases of LPP | CO2 |
| 13 | Practice sessions on simplex algorithm | CO2 |
| 14 | Sensitivity Analysis of LPP | CO3 |
| 15 | Sensitivity Analysis of LPP | CO3 |
| 16 | Sensitivity Analysis of LPP | CO3 |
| 17 | Introduction to Transportation Algorithm | CO2 |
| 18 | Formulation of Transportation Algorithm | CO2 |
| 19 | Transportation Algorithm-Generating basic feasible solution using North-West Corner Rule and Least Cost Method | CO2 |
| 20 | Transportation Algorithm-Generating basic feasible solution using North-West Corner Rule and Least Cost Method | CO2 |
| 21 | Testing for optimality using Stepping Stone Method | CO2 |
| 22 | Testing for optimality using Modified Distribution Method (MODI Method) | CO2 |
| 23 | Maximization case | CO2 |
| 24 | Unbalanced problems and Multiple Optimal Solutions | CO2 |
| 25 | Degeneracy | CO2 |
| 26 | Post Optimality Analysis using transportation algorithm | CO3 |
| 27 | Applications of Transportation Algorithm | CO1 |
| 28 | Applications of Transportation Algorithm | CO1 |
| 29 | Assignment Algorithm-Introduction | CO1 |
| 30 | Solution to balanced and unbalanced assignment problems | CO2 |
| 31 | Applications of Assignment Algorithm | CO2 |
| 32 | Travelling Salesman Problem | CO2 |
| 33 | Queuing Theory-Introduction | CO4 |
| 34 | Single Channel Single Phase models | CO4 |
| 35 | Infinite and Finite Population Models | CO4 |
| 36 | Simulation Models | CO4 |

## Course Articulation Matrix

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO 3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | X | X | | | | | | | | | | | | | |
| CO2 | | X | X | | | | | | | | | | | | |
| CO3 | | | X | X | | | | | | | | | | | |
| CO4 | X | X | X | X | | | | | | | | | | | |
| Articulation Level | M | M | M | M | | | | | | | | | | | |

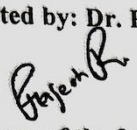
**FACULTY MEMBERS TEACHING THE COURSE (IF MULTIPLE SECTIONS EXIST):**

| FACULTY | SECTION |
|---|---|
| Dr. Mahesh Prabhu H | A |
| Dr. Rajesh R Pai | B |

**References:**


1. Taha, H. A. (2019). Operations Research-An Introduction, Ninth Edition. Pearson.
2. Sharma S D. (2014). Operations Research, KedarNath RamNath & Co.
3. Sharma J K. (2023). Operations Research-Theory and Application, Fifth Edition, Macmillan Publishers.
4. Wagner Harvey M (2009). Principles of Operations Research, Second Edition, Prentice Hall of India.

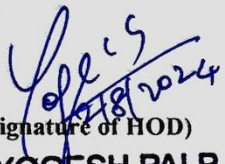

**Submitted by: Dr. Rajesh R Pai**



**(Signature of the faculty)**

**Date: 02.08.2024**

**Approved by: Dr. Yogesh Pai P**



**(Signature of HOD)**

Dr. YOGESH PAI P.
BE., M. BA., M. Phil., Ph. D.
HOD, Humanities & Management
MIT, MANIPAL - 576 104, Karnataka, India