# GUJARAT TECHNOLOGICAL UNIVERSITY

**Syllabus for Master of Business Administration, 3rd Semester**
**Functional Area Specialization: Production and Operations Management**
**Subject Name: Operations Research (OR)**
**Subject Code: 4539271**

## 1. Learning Outcomes:

| Learning Outcome Component | Learning Outcome (Learner will be able to) |
|---|---|
| Business Environment and Domain Knowledge (BEDK) | • *Develop* an understanding and appreciation of linear optimization models as effective tools in addressing problems that are relevant to decision making in business, economics and other related areas. |
| Critical thinking, Business Analysis, Problem Solving and Innovative Solutions (CBPI) | • *Formulate* Linear Programming models for service and manufacturing systems, and apply operations research techniques and algorithms to solve these LP problems. <br> • *Formulate* Network models for service and manufacturing systems, and apply operations research techniques and algorithms to solve these Network problems. |
| Global Exposure and Cross-Cultural Understanding (GECCU) | • *Appraise* the latest mathematical model(s) and software tools to make optimal decisions under conditions of certainty, risk and uncertainty. |
| Social Responsiveness and Ethics (SRE) | • *Formulate* Queuing models for service and manufacturing systems, and *apply* operations research techniques and algorithms to solve these Queuing problems to enhance customer service. |
| Effective Communication (EC) | • *Develop* operational research models from the verbal description of the real system. |
| Leadership and Teamwork (LT) | • *Identify* project goals, constraints, deliverables, performance criteria, control needs, and resource requirements in order to achieve project success. |

**Correlation Levels:**

**1 = Slight (Low); 2 = Moderate (Medium); 3 = Substantial (High), "-"= no correlation**

| Sub. Code: 4539271 | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 |
|---|---|---|---|---|---|---|---|---|---|
| LO1: *Develop* an understanding and appreciation of linear optimization models as effective tools in addressing problems that are relevant to decision making in business, economics and other related areas. | 3 | 3 | 1 | 1 | 1 | 1 | - | 1 | 3 |
| LO2: *Formulate* Linear Programming models for service and manufacturing systems, and apply operations research techniques and algorithms to solve these LP problems. | 2 | 2 | 3 | 2 | 1 | 2 | - | 1 | 2 |
| LO3: *Formulate* Network models for service and | 2 | 2 | 3 | 2 | 1 | 2 | - | 1 | 2 |

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| | | | | | | | | | |
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| manufacturing systems, and apply operations research techniques and algorithms to solve these Network problems. | | | | | | | | | |
| LO4: *Appraise* the latest mathematical model(s) and software tools to make optimal decisions under conditions of certainty, risk and uncertainty. | 3 | 3 | - | - | 3 | - | - | - | 2 |
| LO5: *Formulate* Queuing models for service and manufacturing systems, and *apply* operations research techniques and algorithms to solve these Queuing problems to enhance customer service. | 3 | 3 | 1 | 2 | 1 | 1 | 3 | 1 | 1 |
| LO6: *Develop* operational research models from the verbal description of the real system. | 1 | 2 | 1 | 3 | - | - | 1 | 1 | 2 |
| L07: *Identify* project goals, constraints, deliverables, performance criteria, control needs, and resource requirements in order to achieve project success. | 3 | 1 | 1 | 3 | - | 3 | 1 | 1 | 1 |

2. **Course Duration:** The course duration is of **40 sessions of 60 minutes each.**

3. **Course Contents:**

| Module No: | Contents | No. of Sessions | 70 Marks (External Evaluation) |
|---|---|---|---|
| **I** | **Operations Research:**<br>• Definition, Features of OR approach<br>• Modelling in OR:<br>  o Mathematics – The Language of Modelling<br>  o Classification of models<br>  o Building a Mathematical Model, Verifying and Refining a Model, Variables and Parameters<br>  o Advantages of model building<br>• Methodology of Operations Research<br><br>**Linear Programming:**<br>• Structure of the Linear Programming model | 10 | 18 |

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| | • Advantages, limitations and applications<br>• Guidelines on linear programming model formulation | | |
| **II** | **Linear Programming: Graphical Method: (Theory and numerical)**<br>• Graphical solution methods:<br>• Extreme point solution method, Maximization and Minimization Models, mixed constraints<br>• Alternative optimal solutions, Unbounded Solution, infeasible solution, redundancy<br><br>**Linear Programming: Simplex Method: (Theory and numerical)**<br>• Additional Variables Used in Solving LPP<br>• Maximization Case<br>• Minimization LP Problems<br>   o Two phase method, Big M Method,<br>• Resolving complications<br>   o Unrestricted variables, Degeneracy<br>• Types of solutions<br>   o Optimal, unbounded, infeasible<br><br>**Solving LP Problems using Computer With TORA.**<br>**Duality in LPP Problems**<br>**Sensitivity Analysis (Only theory)** | 10 | 18 |
| **III** | **Transportation Model: (Theory and numerical)**<br>• Mathematical Formulation, Network Representation of Transportation Model, General Representation of Transportation Model.<br>• Finding initial solutions:<br>   ▪ North-West Corner Method, Least Cost Method, Vogel's Approximation Model<br>• Variations:<br>   o Unbalanced supply and demand<br>   o Degeneracy<br>   o Alternative optimal solutions<br>   o Prohibited routes<br>• Maximization Transportation Problem.<br>• Transshipment Problem.<br><br>**Waiting Model (Queuing Theory):**<br>• Queuing Systems, Characteristics of Queuing System<br>• Structure of a queuing system, performance measures, probability distributions in queuing systems<br>• Classification of queuing models<br>• Symbols and Notations,<br>• Single Server Queuing Model<br>• Solving The Problem using Computer with TORA | 10 | 17 |

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| **IV** | **Markov Chains: (Only theory)**<br>• Characteristics, applications<br>• State and transition probabilities<br>• Steady state equilibrium<br><br>**Game Theory:**<br>• Introduction<br>• Two-Person Zero-Sum Game<br>• Pure Strategies: Game with Saddle Point<br>• Mixed Strategies:Games without Saddle Point, Dominance Property<br>• Solving Problem on the Computer with TORA<br>• Solving LP Model Games Graphically Using Computer<br><br>**Simulation:**<br>• Definition, types, steps of simulation<br>• Advantages and Disadvantages of Simulation<br>• Monte Carlo Simulation<br>• Simulation of Demand Forecasting Problems<br>• Simulation of Queuing Problems. | 10 | 17 |
| **V** | **Practical:**<br>• Conduct simulations for transportation, queuing and network problems.<br>• Solve operations management problems using OR tools and techniques.<br>• Conduct OR problems on software. | --- | (30 marks CEC) |

## 4. Pedagogy:
- ICT enabled Classroom teaching
- Case study
- Practical / live assignment
- Interactive class room discussions

## 5. Evaluation:
Students shall be evaluated on the following components:

| | **Internal Evaluation** | **(Internal Assessment- 50 Marks)** |
|---|---|---|
| **A** | • Continuous Evaluation Component | 30 marks |
| | • Class Presence & Participation | 10 marks |
| | • Quiz | 10 marks |
| **B** | **Mid-Semester examination** | **(Internal Assessment-30 Marks)** |
| **C** | **End –Semester Examination** | **(External Assessment-70 Marks)** |

## 6. Reference Books:

| No. | Author | Name of the Book | Publisher | Year of Publication / Edition |
|---|---|---|---|---|
| 1 | S. R. Yadav, A. K. Malik | Operations Research | Oxford | 2014 |

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| | | | | |
|---|---|---|---|---|
| 2 | J. K. Sharma | Operations Research: Theory and Application | Trinity Press | 2017 |
| 3 | Hamdy A. Taha | Operations Research : An Introduction | Pearson | Latest Edition |
| 4 | P. Mariappan | Operations Research | Pearson | 2013 |
| 5 | Frederick S. Hillier, Gerald J. Liberman | Introduction to Operations Research | McGraw Hill | Latest Edition |
| 6 | Prem Kumar Guptha, D. S. Hira | Operations Research | S. Chand | 2014 |

Note: Wherever the standard books are not available for the topic appropriate print and online resources, journals and books published by different authors may be prescribed.

**7. List of Journals / Periodicals/Magazines/Newspapers / Web resources, etc.**

1. International Journal of Operational Research
2. International Journal of Applied Operational Research
3. Opsearch (Journal published by Operational Research Society of India)
4. The IUP Journal of Operations Management
5. http://ifors.org/india/