# Course Specification
## (Bachelor)

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|---|
| **Course Title**: Operations Research I |
| **Course Code**: INE 3321 |
| **Program**: Bachelor of industrial engineering |
| **Department**: Industrial Engineering |
| **College**: College of Engineering |
| **Institution**: King Khalid University, Abha, Saudi Arabia |
| **Version**: 2 |
| **Last Revision Date**: 17-12-2025 |

## Table of Contents

## A. General information about the course:

### 1. Course Identification

| 1. Credit hours: ( 3 ) | | | | | |
|---|---|---|---|---|---|
| | | | | | |
| **2. Course type** | | | | | |
| A. | ☐University | ☐College | ☒ Department | ☐Track | ☐Others |
| B. | ☒ Required | | ☐Elective | | |
| **3. Level/year at which this course is offered: (6/3)** | | | | | |
| **4. Course general Description:** | | | | | |
| **This course introduces the fundamental concepts and techniques of Operations Research (OR) for engineering and management applications. It focuses on developing analytical and quantitative problem-solving skills through the formulation and solution of optimization models. Students learn how to translate real-world decision-making problems into mathematical models and apply appropriate solution methods.<br>The course covers linear programming, including graphical analysis, the Simplex algorithm, the Big-M method, and duality theory with economic interpretation. Emphasis is placed on sensitivity analysis to evaluate the impact of parameter changes on optimal solutions. Classical OR applications such as transportation, and assignment models are studied to address logistics, resource allocation, and flow problems.<br>Through problem solving and practical examples, students gain the ability to analyze complex systems, interpret optimal solutions, and support effective decision making in engineering and industrial systems.** | | | | | |
| **5. Pre-requirements for this course** (if any)**:** | | | | | |
| MATH 2301 | | | | | |
| **6. Co-requisites for this course** (if any)**:** | | | | | |
| NIL | | | | | |
| **7. Course Main Objective(s):** | | | | | |
| **By the end of this course, students will be able to:**<br>**1. Understand the role and importance of Operations Research in engineering and managerial decision-making.**<br>**2. Formulate real-world problems as mathematical optimization models.** | | | | | |

3. **Apply linear programming techniques to solve resource allocation and planning problems.**
4. **Use the Simplex algorithm and Big-M method to obtain optimal solutions for constrained optimization problems.**
5. **Analyze duality theory and interpret its economic and managerial implications.**
6. **Perform sensitivity analysis to assess the impact of changes in model parameters on optimal solutions.**
7. **Solve practical problems using transportation and assignment models.**
8. **Enhance logical, analytical, and quantitative problem-solving skills relevant to industrial and systems engineering applications.**

## 2. Teaching mode (mark all that apply)

| No | Mode of Instruction | Contact Hours | Percentage |
|---|---|---|---|
| 1 | Traditional classroom | 60 | 100 |
| 2 | E-learning | | |
| 3 | Hybrid<br>• Traditional classroom<br>• E-learning | | |
| 4 | Distance learning | | |

## 3. Contact Hours (based on the academic semester)

| No | Activity | Contact Hours |
|---|---|---|
| 1. | **Lectures** | 30 |
| 2. | **Laboratory/Studio** | 15 |
| 3. | **Field** | |
| 4. | **Tutorial** | 15 |
| 5. | **Others (specify)** | |
| **Total** | | 60 |

## B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

| Code | Course Learning Outcomes | Code of CLOs aligned with program | Teaching Strategies | Assessment Methods |
|---|---|---|---|---|
| **1.0** | **Knowledge and understanding** | | | |

| Code | Course Learning Outcomes | Code of CLOs aligned with program | Teaching Strategies | Assessment Methods |
|---|---|---|---|---|
| 1.1 | Demonstrate knowledge of fundamental concepts and principles of Operations Research and optimization. | K1 | | Assignments Midterm Exam Final Exam |
| | Understand linear programming models, assumptions, and solution methods | K2 | | |
| | Explain duality theory and its economic interpretation in decision-making problems. | K3 | | |
| 1.2 | Recognize applications of transportation, assignment, and network models in industrial systems. | K4 | | Assignments Midterm Exam Final Exam |
| **2.0** | **Skills** | | | |
| 2.1 | Formulate real-world engineering problems into appropriate mathematical optimization models. | S1 | | Assignments Midterm Exam Final Exam |
| 2.2 | Solve linear programming problems using graphical and algorithmic methods such as the Simplex method. | S2 | | |
| 2.3 | Apply Big-M and related techniques to | S3 | | |

| Code | Course Learning Outcomes | Code of CLOs aligned with program | Teaching Strategies | Assessment Methods |
|---|---|---|---|---|
| | handle constrained optimization problems | | | |
| 2.4 | Perform sensitivity analysis and interpret the effects of parameter changes on optimal solutions. | S4 | | |
| 2.5 | Analyze and solve transportation and assignment problems efficiently | S5 | | |
| 2.6 | Develop and analyze network models for flow, shortest path, and project scheduling problems. | S6 | | |
| **3.0** | **Values, autonomy, and responsibility** | | | |
| | | | | |

## C. Course Content

| No | List of Topics | Contact Hours |
|---|---|---|
| **1.** | Introduction | 4 |
| **2.** | Formulate Operation Research problems | 6 |
| **3.** | Linear programming | 8 |
| **4.** | Simplex algorithm | 8 |
| **5.** | Big M method | 9 |
| **6.** | Duality and economic analysis | 6 |
| **7.** | Sensitivity analysis | 8 |
| **8.** | Transportation and Assignment Problems | 10 |
| **Total** | | **60** |

## D. Students Assessment Activities

| No | Assessment Activities * | Assessment timing (in week no) | Percentage of Total Assessment Score |
|---|---|---|---|
| **1.** | Assignments | 6, 9,14 | 15% |
| **2.** | Quizzes | 7, 14 | 10% |
| **3.** | Midterm 1 | 7 | 15% |
| **4.** | Case study | 15 | 5% |
| **5.** | Final practical exam | 14 | 15% |
| **6.** | Final exam | 15 | 40% |

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

## E. Learning Resources and Facilities

### 1. References and Learning Resources

| | |
|---|---|
| **Essential References** | • Introduction to Operations Research: 2024 Release, Hillier & Lieberman, 2024, 12th Edition, Mc graw Hill. |
| **Supportive References** | Linear Algebra and its Applications, David c. Lay; Steven R. Lay; Judi J. McDonald, 5th Edition, Pearson, 2015, ISBN-13: 9780321982384, ISBN-10: 032198238x |
| **Electronic Materials** | |
| **Other Learning Materials** | |

### 2. Required Facilities and equipment

| Items | Resources |
|---|---|
| **facilities**<br>(Classrooms, laboratories, exhibition rooms, simulation rooms, etc.) | • Classroom with 50 seats<br>• Laboratory with 25 seats |
| **Technology equipment**<br>(projector, smart board, software) | • Computer system<br>• Projector |
| **Other equipment**<br>(depending on the nature of the specialty) | |

## F. Assessment of Course Quality

| Assessment Areas/Issues | Assessor | Assessment Methods |
|---|---|---|
| Effectiveness of teaching | Student and faculty | Indirect through surveys |
| Effectiveness of Students' assessment | Quality Committee | Direct through Rubrics |

| Assessment Areas/Issues | Assessor | Assessment Methods |
|---|---|---|
| Quality of learning resources | Student and faculty | Indirect through surveys (Student, faculty) |
| The extent to which CLOs have been achieved | | |
| Other | | |

Assessors (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)

## Assessment Methods (Direct, Indirect)

## G. Specification Approval

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|---|---|
| **COUNCIL /COMMITTEE** | **REVIEWED BY CURRICULUM COMMITTEE<br>APPROVED BY QUALITY COMMITTEE** |
| **REFERENCE NO.** | **9-6-47** |
| **DATE** | **25/06/1447** |