



# Course Specifications

|                      |                                   |
|----------------------|-----------------------------------|
| <b>Course Title:</b> | Operational research              |
| <b>Course Code:</b>  | CSI 445                           |
| <b>Program:</b>      | Information and computer sciences |
| <b>Department:</b>   | Computer science and information  |
| <b>College:</b>      | Science at Al-Zulfi               |
| <b>Institution:</b>  | Majmaah                           |

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## A. Course Identification

|  |
|--|
| <b>1. Credit hours:</b>  |
| <b>2. Course type</b>  |
| a. University <input type="checkbox"/> College <input type="checkbox"/> Department <input checked="" type="checkbox"/> Others <input type="checkbox"/> |
| b. Required <input type="checkbox"/> Elective <input checked="" type="checkbox"/>  |
| <b>3. Level/year at which this course is offered: 2</b>  |
| <b>4. Pre-requisites for this course (if any):</b> Computer Programming (CSI 445)  |
| <b>5. Co-requisites for this course (if any):</b>  |

### 6. Mode of Instruction (mark all that apply)

| No | Mode of Instruction   | Contact Hours | Percentage |
|----|-----------------------|---------------|------------|
| 1  | Traditional classroom | *             | %80        |
| 2  | Blended               | *             | %5         |
| 3  | E-learning            | *             | %5         |
| 4  | Correspondence        | *             | %5         |
| 5  | Other                 | *             | %5         |

### 7. Actual Learning Hours (based on academic semester)

| No                           | Activity                        | Learning Hours |
|------------------------------|---------------------------------|----------------|
| <b>Contact Hours</b>         |                                 |                |
| 1                            | Lecture                         | 30             |
| 2                            | Laboratory/Studio               |                |
| 3                            | Tutorial                        | 30             |
| 4                            | Others (specify)                |                |
|                              | <b>Total</b>                    | 60             |
| <b>Other Learning Hours*</b> |                                 |                |
| 1                            | Study                           |                |
| 2                            | Assignments                     |                |
| 3                            | Library                         |                |
| 4                            | Projects/Research Essays/Theses |                |
| 5                            | Others (specify)                |                |
|                              | <b>Total</b>                    |                |

\* The length of time that a learner takes to complete learning activities that lead to achievement of course learning outcomes, such as study time, homework assignments, projects, preparing presentations, library times

## B. Course Objectives and Learning Outcomes

### 1. Course Description

Operations research (OR) seeks the determination of the best (optimum) course of action of a decision problem under the restriction of limited resources. The term operations research quite of-ten is associated almost exclusively with the use of mathematical techniques to model and analyze decision problems. Although mathematics and mathematical models represent a corner stone of OR, there is more to problem solving than the construction and solution of mathematical models. Specifically, decision problems usually include important intangible factors that cannot be translated directly in terms of the mathematical model. Foremost among these factors is the presence of the human element in almost every decision environment. Indeed, decision situations have been reported where the effect of human behavior has so influenced the decision problem that the solution obtained from the mathematical model is deemed impractical.

### 2. Course Main Objective

The purpose of this course is to enable the student to:

1. Understand and apply the paradigm What is, why we need, how to use tools of, and Where/When to apply: Optimization.
2. Recognize the concept of Absolute Extrema, and the concept of Lagrange Multiplier to determine the conditional Extrema.
3. Determine the type of solution (and find this solution if it exists) for a system of linear equations.
4. Establish linear programming as one of the Operations Research techniques used in planning for utilizing available resources with the best possible manner.
5. Be familiar with the mathematical properties of linear programming models, by graphical and algebraic concepts.
6. Explore practical applications that can be solved by linear programming and the ability to formulate linear programming problems.
7. Apply professionally the Simplex method to solving linear programming problems, then performing sensitivity analysis on optimal solution.
8. Interpret and apply the Duality process.
9. Construct and solve applications of the Transportation Model and its Variants.

### 3. Course Learning Outcomes

| CLOs |  | Aligned PLOs |
|------|--|--------------|
| 1    | <b>Knowledge:</b>  |              |
| 1.1  | Describe exactly and in a formal manner the type of a considered optimization problem. | a1           |
| 1.2  | Recall and list different methods to attack a problem.                                 | a1           |
| 1.3  | Recognize the concepts and mathematical models of Linear programming.                  | a1           |
| 1.4  | Match correctly the appropriate techniques of solutions with the concerned problems.   | a1           |
| 2    | <b>Cognitive Skills</b>  |              |
| 2.1  | Reconstruct, reorganize and analyze an optimization problem.                           |              |
| 2.1  | Plan and explain how to solve an optimization problem.                                 | b1           |
| 2.2  | Reorganize the relationships between a linear programming problem and other objects.   | b1           |

| CLOs     |  | Aligned PLOs |
|----------|--|--------------|
| 2.3      | Differentiate and compare between the alternative solutions of a linear programming problem to justify the optimal one.                | b1           |
| 2.4      |  | b1           |
| 2.5      |  | b1           |
| <b>3</b> | <b>Interpersonal Skills &amp; Responsibility</b>   |              |
| 3.1      | Illustrate a plan to attack and solve a LP problem   | b1           |
| 3.2      | Use the available commercial software systems/packages in application to the suggested solution/plan.                                  | b1           |
| 3.3      | Demonstrate the feasibility of an applied solution/plan  | b1           |
|          | Analyze the solution's sensitivity due to modifications on a problem.  | b1           |
|          |  |              |
|          | <b>Communication, Information Technology, Numerical</b>  |              |
| 4.1      | Team working skills: cooperative working in groups inside the class, or/and efficient participation in take-home-assignments.          |              |
| 4.2      | Oral Skills: save the students' time and allow them to feel "involved" in the discussion, rather than simply being outside spectators. |              |
| 4.3      | Communication skills : a video conference help the student to skip the fear-threshold of scientific interaction.                       |              |
|          |  |              |
|          |  |              |
|          |  |              |
|          |  |              |

### C. Course Content

| No           | List of Topics  | Contact Hours |
|--------------|---|---------------|
| 1            | 1) Introduction and Basic Concepts of Optimization: Absolute Extrema, and Conditional Extrema. Solution of Systems of Linear of Equations.  | 12            |
| 2            | 2) What is Operational Research: Operational Research Models. Solving the OR Model. Art of Modeling. Solution of Systems of Linear Inequalities in Two Variables. Convexity.  | 8             |
| 3            | 3) Linear Programming (Graphical Solution): Two Variables LP Model. Applications: Manufacturing/Construction/Scheduling/Education with resource allocation, Nutrition, Psychology, Medicine, Agriculture, Transportation, Investment, Pollution Control, Capital Expansion, Sociology, Advertising, Opinion Survey, Purchasing. | 16            |
| 4            | 4) Linear Programming (Analytical Solution): Computational Details of the Simplex Algorithm. Applications. Algebraic Sensitivity Analysis due to Changes in the Right-hand Side. Degeneracy Difficulties. Dual Simplex Algorithm  | 16            |
| 5            | 5) Transportation Model and its Variants: Definition of the model. Nontraditional Transportation Model. The Transportation Algorithm.   | 8             |
|              |   |               |
| <b>Total</b> |   |               |

## D. Teaching and Assessment

### 1. Alignment of Course Learning Outcomes with Teaching Strategies and Assessment Methods

| Code       | Course Learning Outcomes | Teaching Strategies   | Assessment Methods  |
|------------|--------------------------|---|---|
| <b>1.0</b> | <b>Knowledge</b>         |   |   |
| 1.1        |                          | <ul style="list-style-type: none"> <li>• Developing basic communication</li> <li>• Ability through short and varied situated discourse.</li> <li>• Lecturing</li> <li>• Team work</li> <li>• Exercises</li> </ul>   | <ul style="list-style-type: none"> <li>• Homework.</li> <li>• Group Discussion</li> <li>• Presentation</li> <li>• Mid-term exam</li> <li>Final test</li> </ul>  |
| 1.2        |                          |   |   |
| ...        |                          |   |   |
| <b>2.0</b> | <b>Skills</b>            |   |   |
| 2.1        |                          | <ul style="list-style-type: none"> <li>• Problem solving</li> <li>• Class discussion</li> <li>• Presentation</li> </ul> Individual meeting with the instructor (encouraging students to discuss different topics outside the classroom)   | <ul style="list-style-type: none"> <li>• Class Participation</li> <li>• Presentation</li> <li>• Essay Questions</li> <li>Research topics</li> </ul>   |
| 2.2        |                          |   |   |
| ...        |                          |   |   |
| <b>3.0</b> | <b>Competence</b>        |   |   |
| 3.1        |                          | <ul style="list-style-type: none"> <li>• Discussion with students</li> <li>• Making students aware about time management in completing their assignments.</li> <li>• Counsel students how to make a good presentation in Database and DBMS</li> </ul> Encourage students to help each | <ul style="list-style-type: none"> <li>• Respecting deadlines.</li> <li>• Showing active class participation.</li> <li>• Helping other students to understand tasks in the class.</li> <li>• Giving clear and logical arguments</li> </ul> Performing seriously on midterms and final exams |
| 3.2        |                          |   |   |
| ...        |                          |   |   |

### 2. Assessment Tasks for Students

| # | Assessment task*                                  | Week Due            | Percentage of Total Assessment Score |
|---|---|---------------------|--------------------------------------|
| 1 | First written mid-term exam                       | 6                   | 15%                                  |
| 2 | Second written mid-term exam                      | 12                  | 15%                                  |
| 3 | Class activities, group discussions, Presentation | Every week          | 5%                                   |
| 4 | Homework + Assignments                            | After Every chapter | 5%                                   |
| 6 | Final written exam                                | 16                  | 40%                                  |
| 7 | First written mid-term exam                       | 6                   | 15%                                  |

\*Assessment task (i.e., written test, oral test, oral presentation, group project, essay, etc.)

## E. Student Academic Counseling and Support

**Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice :**

Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice. (include amount of time teaching staff are expected to be available each week)

**Office hours: Mon: 10-12, Wed: 8-10**

**Email: m.jemmali@mu.edu.sa**

## F. Learning Resources and Facilities

### 1. Learning Resources

|                                       |  |
|---------------------------------------|--|
| <b>Required Textbooks</b>             | 1. Hamdy A. Taha; Operations Research: An Introduction; 9th Edition, Prntice Hall, 2010.   |
| <b>Essential References Materials</b> | • Ali Emrouznejad, William Ho; Applied Operational Research with SAS; Chapman and Hall/CRC, December 2011.   |
| <b>Electronic Materials</b>           | <a href="http://fisher.osu.edu/~croxton_4/tutorial/">http://fisher.osu.edu/~croxton_4/tutorial/</a><br><a href="http://people.hofstra.edu/Stefan_Waner/realworld/LPGrapher/lpg.html/">http://people.hofstra.edu/Stefan_Waner/realworld/LPGrapher/lpg.html/</a><br><a href="http://people.hofstra.edu/Stefan_Waner/realworld/simplex.html">/http://people.hofstra.edu/Stefan_Waner/realworld/simplex.html</a> |
| <b>Other Learning Materials</b>       | Excel software.<br>2. TORA software.<br>3. STORM software.<br>4. Net search for highly well achieved systems: Educational, Transportation, Cultural, Social, Economic.   |

### 2. Facilities Required

| <b>Item</b>  | <b>Resources</b>  |
|--|---|
| <b>Accommodation</b><br>(Classrooms, laboratories, demonstration rooms/labs, etc.)   | <ul style="list-style-type: none"> <li>Classrooms with required digital aids and to support traditional method of teaching using blackboard.</li> <li>Classrooms with proper lighting and air conditioning system integrated with the sound System /audio system.</li> <li>Classroom with smart board interface, display screen and a computer to aid the sessions</li> </ul> |
| <b>Technology Resources</b><br>(AV, data show, Smart Board, software, etc.)  | Smart Board with supporting software / computers with updated versions of software as required to understand the subject concepts.  |
| <b>Other Resources</b><br>(Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list) |   |

## G. Course Quality Evaluation

| Evaluation Areas/Issues   | Evaluators      | Evaluation Methods |
|---|-----------------|--------------------|
| Student-faculty management meetings.  | Program Leaders | Direct             |
| Discussion within the staff members teaching the course                                   | Peer Reviewer   | Direct             |
| Departmental internal review of the course.   | Peer Reviewer   | Direct             |
| Reviewing the final exam questions and a sample of the answers of the students by others. | Peer Reviewer   | Direct             |
| Visiting the other institutions that introduce the same course one time per semester.     | Faculty         | Indirect           |
| Student-faculty management meetings.  | Program Leaders | Direct             |
| Discussion within the staff members teaching the course                                   | Peer Reviewer   | Direct             |

**Evaluation areas** (e.g., Effectiveness of teaching and assessment, Extent of achievement of course learning outcomes, Quality of learning resources, etc.)

**Evaluators** (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify))

**Assessment Methods** (Direct, Indirect)

## H. Specification Approval Data

|                            |                        |
|----------------------------|------------------------|
| <b>Council / Committee</b> | Program plan committee |
| <b>Reference No.</b>       |                        |
| <b>Date</b>                | 08/09/2019             |