



# Course Specification

## (Bachelor)

Course Title: **Quantitative Method for Software Engineering**

Course Code: **SE4716**

Program: **BSc in Software Engineering**

Department: **Software Engineering**

College: **College of Computing**

Institution: **Umm Al Qura University**

Version: **1.0**

Last Revision Date: **22/04/2025**



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## 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: ( 3<sup>rd</sup> year/ 5<sup>th</sup> or 6<sup>th</sup> level) or ( 4<sup>th</sup> year/8<sup>th</sup> level)

#### 4. Course General Description:

This course introduces quantitative techniques essential for decision-making and problem-solving in software engineering. The focus is on operations research methods and their application to optimize software development processes, resource allocation, and project management. Topics include mathematical modeling, linear programming, simulation, and decision analysis, tailored to address challenges in software engineering.

#### 5. Pre-requirements for this course (if any):

CS2105 - Data Structures and Algorithms with Java

#### 6. Co-requisites for this course (if any):

N/A

#### 7. Course Main Objective(s):

Upon successful completion of this course, you will be able to:

1. Equip students with mathematical and analytical tools to model and solve software engineering problems.
2. Apply operations research methods to optimize software project management, resource allocation, and scheduling.
3. Analyze data quantitatively to support evidence-based decision-making in software engineering.
4. Explore simulation techniques for software process modeling and performance evaluation.

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

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	45	100%



No	Mode of Instruction	Contact Hours	Percentage
2	E-learning	0	0
3	Hybrid <ul style="list-style-type: none"> <li>Traditional classroom</li> <li>E-learning</li> </ul>	0	0
4	Distance learning	0	0

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

No	Activity	Contact Hours
1.	Lectures	45
2.	Laboratory/Studio	0
3.	Field	0
4.	Tutorial	0
5.	Others (specify)	0
<b>Total</b>		<b>45</b>

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

Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
<b>1.0</b>	<b>Knowledge and understanding</b>			
1.1	Understand the principles of quantitative methods and operations research.	K1	Lecture, Exercise	Quiz, Exams, Assignments
1.2	Explain mathematical modeling techniques relevant to software engineering problems.	K2	Lecture, Exercise	Quiz, Exams, Assignments
<b>2.0</b>	<b>Skills</b>			
2.1	Formulate and solve optimization problems using linear programming techniques.	S1	Lecture, Exercise	Quiz, Exams, Assignments



Code	Course Learning Outcomes	Code of PLOs aligned with the program	Teaching Strategies	Assessment Methods
2.2	Design solutions to software engineering problems using decision analysis methods.	S2	Lecture, Exercise	Quiz, Exams, Assignments
2.3	Conduct simulation experiments to analyze and improve software processes.	S3	Lecture, Exercise	Quiz, Exams, Assignments
2.4	Document and present quantitative models and findings to technical and non-technical audiences.	S4	Lecture, Exercise	Quiz, Exams, Assignments
<b>3.0</b>	<b>Values, autonomy, and responsibility</b>			
3.1	Collaborate with team members to develop quantitative models for software projects.	V2	Lecture, Exercise	Quiz, Exams, Assignments
3.2	Evaluate the societal and environmental implications of optimization decisions in software engineering.	V1	Lecture, Exercise	Quiz, Exams, Assignments

### C. Course Content

No	List of Topics	Contact Hours
1.	Introduction to Quantitative Methods for Software Engineering	3
2.	Fundamentals of Operations Research	3
3.	Mathematical Modeling in Software Engineering	3
4.	Linear Programming: Concepts and Applications	3
5.	Linear Programming: Duality and Sensitivity Analysis	3
6.	Integer and Mixed-Integer Programming	3
7.	Decision Analysis and Multi-Criteria Decision Making	3
8.	Network Models: Critical Path Method (CPM) and PERT	3
9.	Queuing Theory and Its Applications in Software Processes	3
10.	Simulation Techniques for Software Systems	3
11.	Optimization Techniques for Resource Allocation	3
12.	Case Studies in Operations Research for Software Engineering	6
13.	Group Projects: Real-world Quantitative Analysis	6
<b>Total</b>		<b>45</b>





## D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	Quizzes	2-14	15
2.	Projects	2-14	15
3.	Assignments	2-14	10
4.	Mid Term	7	20
5.	Final Exam	16-17	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

<b>Essential References</b>	<ul style="list-style-type: none"> <li>Taha, H. A. (2018). <i>Operations Research: An Introduction, Global Edition</i>. Pearson Higher Ed.</li> </ul>
<b>Supportive References</b>	<ul style="list-style-type: none"> <li>Canela, M. Á., Alegre, I., &amp; Ibarra, A. (2019). <i>Quantitative methods for management: A Practical Approach</i>. Springer.</li> <li>Wisniewski, M., &amp; Shafti, F. (2019). <i>Quantitative Analysis for Decision Makers, 7th Edition (Formally known as Quantitative Methods for Decision Makers)</i>. Pearson UK.</li> <li>Kelton, W. D., Sadowski, R. P., Swets, N. B., &amp; Zupick, N. B. (2014). <i>Simulation with Arena</i>. College Ie Overruns.</li> <li>Tovey, C. A. (2024). <i>Linear optimization and duality: A Modern Exposition</i>.</li> </ul>
<b>Electronic Materials</b>	
<b>Other Learning Materials</b>	

### 2. Required Facilities and equipment

Items	Resources
<b>facilities</b> (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	Traditional Classroom
<b>Technology equipment</b> (projector, smart board, software)	Multimedia Projector
<b>Other equipment</b> (depending on the nature of the specialty)	MATLAB or Python for quantitative analysis. LINDO/LINGO for linear and integer programming. Arena or AnyLogic for simulation.





Items	Resources
	MS Excel for basic modeling and optimization

## F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Students	Direct, Indirect
Effectiveness of Students assessment	Faculty, Peer reviewer	Direct, Indirect
Quality of learning resources	Faculty, Course coordinator	Direct, Indirect
The extent to which CLOs have been achieved	Course coordinator, Program management committee	Direct
Other		

**Assessors** (Students, Faculty, Program Leaders, Peer Reviewers, Others (specify))

**Assessment Methods** (Direct, Indirect)

## G. Specification Approval

<b>COUNCIL /COMMITTEE</b>	<b>SOFTWARE ENGINEERING DEPARTMENT COUNCIL</b>
<b>REFERENCE NO.</b>	<b>THE 17<sup>TH</sup> MEETING FOR THE ACADEMIC YEAR 1446H</b>
<b>DATE</b>	<b>22/04/2025</b>

