Detailed Course Description - Course Plan Development and Updating Procedures/ Mathematics Department	QF01/0408-3.0E

Faculty	**Faculty of Science and Information Technology**	Department	**Mathematics**
Course number	**0101471**	Course title	**Mathematical Modeling (2)**
Number of credit hours	**3**	Pre-requisite/co-requisite	**Mathematical Modeling (1) (0101372)**

Brief course description
This course is an introduction to mathematical modeling using tools from various parts of mathematics to describe and explore real-world data and phenomena. A variety of modeling techniques will be discussed with examples taken from physics, biology, chemistry, economics and other fields.

	Course goals and learning outcomes
Goal 1	Seeking the connections between mathematics and the real world.
Learning outcomes	1.1 Solve applications using a variety of problem solving strategies including geometric and algebraic techniques. 1.2 Solve multiple-step problems through different (inductive, deductive, and symbolic) modes of reasoning. 1.3 Express mathematical information, concepts, and thoughts in verbal, numeric, graphical and symbolic forms while solving a variety of problems.
Goal 2	Enable students to build mathematical models of real-world systems
Learning outcomes	2.1 Modeling using matrices. 2.2 Modeling using linear programs. 2.3 Modeling using graphs and networks. 2.4 Modeling with differential equations.
Goal 3	Enable students to analyze and make predictions about the behavior of various modeling systems.
Learning outcomes	3.1 Use appropriate technology in the evaluation, analysis, and synthesis of information in problem solving situations given a set of data from real-world situations.

Textbook	A First Course in Mathematical Modeling by F. Giordano, W. Fox and S. Horton, 5th Ed., Cengage, 2013.
Supplementary references	1. "Concepts of Mathematical Modeling", by J. Meyer, (2004), Dover Publications, ISBN 0-486-4315-6. 2. " Mathematical Modeling", by Stefan Heinz, (2011), Springer, ISBN 978-3-642-20310-7 3. " Principles of Mathematical Modeling, by Clive L. Dym, 2nd Ed., (2004), Elsevier Inc., ISBN: 0-12-226551-3. 4. " Mathematical Modeling", by Mark M. Meerschaert, 4th Ed., (2013), Academic Press (Elsevier Inc.), ISBN: 978-0-12-386912-8.

Course timeline			
Week	**Number of hours**	**Course topics**	**Pages (textbook)**
01	**1** **1** **1**	What is Mathematical Modeling? Steps of the Modeling Process. An Example.	**Later**
02	**1** **1** **1**	Plotting data, proportionality. Fitting linear data visually. Functions we should recognize on sight. Fitting $y=Cx^k$.	
03	**1** **1** **1**	Introduction to MATLAB. Plotting functions and data in MATLAB. Fitting curves to data in MATLAB.	
04	**1** **1** **1**	Modeling exponential data. Modeling exponential data. Exponential growth.	
05	**1** **1** **1**	Method of least squares. Interpolation and extrapolation.	
06	**1** **1** **1**	Review of vectors and matrices Transition matrix. Modeling using Leslie matrices. Some examples in MATLAB. **Exam 1 20% (may consists of a written exam 15% + a project 5%)**	
07	**1** **1** **1**	Optimization using calculus. Linear optimization.	
08	**1** **1** **1**	Formulation of linear programs. Graphical solution of linear programs. Some examples in MATLAB.	
09	**1** **1** **1**	The theory of linear programming. The simplex method.	

10	**1** **1** **1**	Duality in linear programming. Sensitivity analysis in linear programming.	
11	**1** **1** **1**	Integer programming. Branch and bound method. Travelling salesman problem.	
12	**1** **1** **1**	**Exam 2 20% (may consists of a written exam 15% + a project 5%)** Modeling with graphs. Shortest-path problems.	
13	**1** **1** **1**	Minimum spanning tree. Maximum-flow problems. Graph coloring.	
14	**1** **1** **1**	Modeling with differential equations. Graphical solution.	
15	**1** **1** **1**	Euler's method. Runge-Kutta method. Some examples in MATLAB.	
16	**1** **1** **1**	**Final Exam 50% (may consists of a written exam 40% + a project 10%)**	

Theoretical course evaluation methods and weight	Participation = 10% First exam 20% Second exam 20% Final exam 50%	**Practical (clinical) course evaluation methods**	Semester students' work = 50% (Reports, research, quizzes, etc.) Final exam = 50%

Approved by head of department		**Date of approval**	

Extra information (to be updated every semester by corresponding faculty member)

Name of teacher	**Amal H. Al-Saket**	Office Number	**9114**
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Office hours			