QF01/0408-4.0E	Course Plan for Bachelor program - Study Plan Development and Updating Procedures/ Department of Mathematics

Study plan No.	**2021/2022**		**University Specialization**	**Bachelor of Mathematics**	
Course No.	**0101471**		**Course name**	**Mathematical Modeling 2**	
Credit Hours	**3**		**Prerequisite/ Co-requisite**	.....	
Course type	☐ MANDATORY UNIVERSITY REQUIREMENT	☐ UNIVERSITY ELECTIVE REQUIREMENTS	☐ FACULTY MANDATORY REQUIREMENT	☐ Support course family requirements	☐ Mandatory requirements **Elective requirements**
Teaching style	☐ Full online learning		▪ **Blended learning**	☐ Traditional learning	
Teaching model	☐ 1 Synchronous: 1 asynchronous		▪ **1 face to face : 1 asynchronous**	☐ 2 Traditional	

Faculty member and study divisions' information (to be filled in each semester by the subject instructor)

Name	Academic rank	Office No.	Phone No.	E-mail	
Division number	**Time**	**Place**	**Number of students**	**Teaching style**	**Approved model**
1				**Blended**	

Brief 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 linear programming, Graph theory, Differential and methods of solving matrices, Using of Matlab will take a part of this course. Finally, we study the expansion of polynomials by different methods.

Learning resources

Course book information (Title, author, date of issue, publisher ... etc)	1. A First Course in Mathematical Modeling by F. Giordano, W. Fox and S. Horton, 5th Ed., Cengage, 2013.			
Supportive learning resources (Books, databases, periodicals, software, applications, others)	2. "Concepts of Mathematical Modeling", by J. Meyer, (2004), Dover Publications, ISBN 0-486-4315-6. 3. " Mathematical Modeling", by Stefan Heinz, (2011), Springer, ISBN 978-3-642-20310-7 4. " Principles of Mathematical Modeling, by Clive L. Dym, 2nd Ed., (2004), Elsevier Inc., ISBN: 0-12-226551-3. 5. " Mathematical Modeling", by Mark M. Meerschaert, 4th Ed., (2013), Academic Press (Elsevier Inc.), ISBN: 978-0-12-386912-8.			
Supporting websites	1. https://link.springer.com/chapter/10.1007/978-3-319-44234-1_4			
The physical environment for teaching	✓ Class room	☐ labs	✓ Virtual educational platform	☐ Others
Necessary equipment and software	Matlab			
Supporting people with special needs				

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For technical support	Lab Supervisor

Course learning outcomes (S= *Skills, C= Competences K= Knowledge,)*

No.	Course learning outcomes	The associated program learning output code
	Knowledge	
K1	Produce methods for solving applications using a variety of problems, solving strategies including geometric and algebraic techniques.	**MK 1**
K2	Express mathematical information, concepts, and thoughts in verbal, numeric.	**MK 2**
K3	Analyze multiple-step problems through different (inductive, deductive, and symbolic) modes of reasoning.	**MK 2**
	Skills	
S1	Initiate models using matrices.	**MS1**
S2	Build models using linear programs.	**MS2**
S3	Plot models using graphs and networks.	**MS3**
S4	Perform models using expansion and least squares	**MS3**
	Competences	
C1	Reaching the use of applied mathematics for solving real live problems	**MC1**
C2	Cooperate to work effectively in the group assignments.	**MC 1**

Mechanisms for direct evaluation of learning outcomes

Type of assessment / learning style	Fully electronic learning	Blended learning	Traditional Learning (Theory Learning)	Traditional Learning (Practical Learning)
Midterm exam	30%	**30%**	40%	30%
Participation / practical applications	0	**0**	10%	30%
Asynchronous interactive activities	30%	**20%**	0	0
Final exam	40%	**50%**	50%	40%

Schedule of simultaneous / face-to-face encounters and their topics

Week	Subject	learning style	Reference
1	What is Mathematical Modeling? Steps of the Modeling Process. An Example.	Lecture	Ref 1 (25-40)
2	Plotting data, proportionality. Fitting linear data visually. Functions we should recognize on sight. Fitting y(x)	Lecture	Ref 1 (41-60)
3	Introduction to optimization.	Lecture	Ref 1 (61-90)
4	Modeling exponential data. Modeling exponential data. Exponential growth.	Lecture	Ref 1 (91-110)
5	Method of least squares. Interpolation and extrapolation.	Lecture	Ref 1 (11-120)
6	Review of vectors and matrices. Transition matrix. Modeling using Leslie matrices. Some examples in MATLAB.	Lecture	Ref 1 (121-135)

7	Optimization using calculus. Linear optimization.	Lecture	Ref 1 (136-145)
8	Formulation of linear programs. Graphical solution of linear programs. Some examples in MATLAB.	Lecture	Ref 1 (145-180)
9	**Midterm Exam:** The theory of linear programming. The simplex method.	Blended	Ref 1 (200-217)
10	Duality in linear programming. Sensitivity analysis in linear programming.	Blended	Ref 1 (218-240)
11	Integer programming. Branch and bound method. Travelling salesman problem.	Blended	Ref 1 (241-260)
12	Modeling with graphs. Shortest-path problems.	Blended	Ref 2 (180-200)
13	Minimum spanning tree. Maximum-flow problems. Graph coloring.	Blended	Ref 2 (201-220)
14	Modeling with differential equations. Graphical solution.	Blended	Ref 2 (221-240)
15	Euler's method. Bezier method. Some examples in MATLAB.	Blended	Ref 2 (241-260)
16	**Final Exam**		

Schedule of asynchronous interactive activities (in the case of e-learning and blended learning)

Week	Task / activity	Reference	Expected results
1	Background	Ref 1	Self-reading and Discussion
2	Video 1 Solving exercises	Ref 1	Discussion in the class
3	Home work1: On the basics	Ref 1	Submit a pdf or word sheet
4	Quiz 1	Ref 1	Submitting on the E-learning
5	Assignment 1: On Linear programming	Ref 1	Talk
6	Video 2	Ref 1	Discussion in the class
7	Home work 2 On the subjects studied in weeks 4,5 and 6	Ref 1	Submit a pdf or word sheet
8	Assignment 2: On Matrices	Ref 1	Submitted with the mid exam
9	Self-reading	Ref 2+Ref 3	Talk
10	Video3 Solving exercises	Ref 2+Ref 3	Discussion in the class
11	Home work 3: On the subjects studied after the Mid-Exam	Ref 2+Ref 3	Submit a pdf or word sheet
12	Self-reading	Ref 2+Ref 3	Talk
13	Quiz 2	Ref 2+Ref 3	Submitting on the E-learning
14	Presentation of the subject: Expansion and optimization	Ref 4 + Ref 5	Video presentation
15	Video 4 Revision of all the course	Ref 1-5	Self-reading and Discussion
16	**Final Exam**	-	-