Course Unit Title	Modeling of Biological Systems
Course Unit Code	BME340
Type of Course Unit	Compulsory
Level of Course Unit	3rd year BSc program
National Credits	4
Number of ECTS Credits Allocated	6
Theoretical (hour/week)	3
Practice (hour/week)	-
Laboratory (hour/week)	2
Year of Study	3
Semester when the course unit is delivered	4
Course Coordinator	Assist. Prof. Dr. Dilber Uzun Özşahin
Name of Lecturer (s)	Assist. Prof. Dr. Dilber Uzun Özşahin
Name of Assistant (s)	-
Mode of Delivery	Face to Face.
Language of Instruction	English
Prerequisites	MAT201, (Differential Equations)
Recommended Optional Programme Components	

Course description:
This course introduces the current approaches for mathematical modelling and analysis of biological systems using both computer simulation and mathematical techniques. The course reviews the basics of modelling methodology, stochastic and deterministic models, numerical and analytical methods, and model validation. Examples throughout the course are drawn from population dynamics, biochemical networks, ecological models, neuronal modelling, and physiological systems.

Objectives of the Course:

- The objective of this course is to introduce students the concepts of human physiology and mechanisms of physiological control.

Learning Outcomes

At the end of the course the student should be able to		Assessment
1	Awareness of the concepts of modelling and simulation.	1,2
2	Awareness of control techniques and ability to apply them to breathing, glucose regulation, cardiovascular and human muscle-reflex systems.	1,2
3	Ability to model and simulate physiological systems.	1,2
4	Adequate knowledge in parametric identification and optimal control of physiological systems.	1,2

Assessment Methods: 1. Written Exam, 2. Assignment, 3. Project/Report, 4. Presentation, 5. Lab. Work

Course's Contribution to Program

		CL

1	Apply knowledge of mathematics, natural science with relevant to life science and multidisciplinary context of engineering science.	4
2	Analyze, design and conduct experiments, as well as to analyze and interpret data.	4
3	Design a system, component or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability and sustainability.	4
4	Function on multidisciplinary teams.	4
5	Control in design work, by using simulation, modelling and tests and integration in a problem solving oriented way.	4
6	Display an understanding of professional and ethical responsibility.	3
7	Communicate effectively aware of the non-technical effects of engineering.	2
8	Search technical literature and other information sources.	3
9	Recognize of the need for, and an ability to engage in life-long learning.	2
10	Exhibit a knowledge of contemporary issues.	2
11	Use the techniques, skills and modern engineering tools necessary for engineering practice to develop marketable products for the global market.	4

CL: Contribution Level (1: Very Low, 2: Low, 3: Moderate, 4: High, 5: Very High)

Course Contents

Week	Chapter	Topics	Assessment
1	1	Introduction to Biochemical Systems	
2	1	Conventions and calculations in biochemical systems Introduction to scientific programming with Phython	
3	1	Chemical kinetics and transport processes Flow control: loops and Boolean operations.	Assignment I
4	1	Enzyme-catalyzed reactions: cycles, transients, and non-equilibrium steady-states. Phython data types and functions	Assignment I (Due) Projects Start
5	2	Biochemical signaling and modules Phython classes	Assignment II
6	2	Biochemical reaction networks File I/O and error handling	
7		Coupled biochemical systems and membrane transport Plotting with Matplotlib	Assignment II (Due)
8	3		Midterm Exam
9	3	Stochastic biochemical systems and the chemical master equation I Stochastic biochemical systems and the chemical master equation II	
10	3	Difference and differential equations Spatially distributed systems and reaction-diffusion modeling I	
11	3	Random numbers and stochastic simulation Spatially distributed systems and reaction-diffusion modeling II	
12	4	Partial differential equations constraint-based analysis of biochemical systems	

13	4	Linear Algebra Biomacromolecular structure and molecular associations	
14	5	Demonstration:PyMOL Review	
15			Final Exam Project Submission and Presentations

Recommended Sources

Textbook:

1- Daniel A. Beard and Hong Quian. Chemical Biophysics: Quantitative Analysis of Cellular Systems, 2008. Cambridge University Press. ISBN: 978-0-521-87070-2
2- Darren J. Wilkinson. Stochastic Modeling for Systems Biology. 2006. Chapman & Hall/CRC Mathematical and Computation Biology. ISBN: 978-1-584-88540-5
3- Hans P. Langtangen. A Premier on Scientific Programming with Phyton. 2009. Springer-Verlag. ISBN: 978-3-642-02474-0

Supplementary Course Material

Assessment

Quiz	10%	
Assignment	10%	
Midterm Exam	30%	Written Exam
Final Exam	35%	Written Exam
Lab	15%	
Total	100%	

Assessment Criteria

Final grades are determined according to the Near East University Academic Regulations for Undergraduate Studies

Course Policies

- Attendance to the course is mandatory.
- Late assignments will not be accepted unless an agreement is reached with the lecturer.
- Students may use calculators during the exam.
- Cheating and plagiarism will not be tolerated. Cheating will be penalized according to the Near East University General Student Discipline Regulations

ECTS allocated based on Student Workload

Activities	Number	Duration (hour)	Total Workload(hour)
Course duration in class (including Exam weeks)	16	3	48
Labs and Tutorials	3	2	6
Assignment	-	-	-
Project/Presentation/Report	2	2	4
E-learning activities	-	-	-
Quizzes	-	-	-
Midterm Examination	1	15	15
Final Examination	1	20	20
Self-Study	14	5	70
Total Workload			160
Total Workload/30(h)			5.4
ECTS Credit of the Course			5