MSc program, Biomedical Engineering Department

Course Unit Title	Modeling of Complex Biological Systems
Course Unit Code	BME590
Type of Course Unit	Elective
Level of Course Unit	Master of Science Level
National Credits	3
Number of ECTS Credits Allocated	10
Theoretical (hour/week)	4
Practice (hour/week)	-
Laboratory (hour/week)	-
Year of Study	-
Semester when the course unit is delivered	-
Course Coordinator	Assist. Prof. Dr. Mahmut Çerkez
Name of Lecturer (s)	Assist. Prof. Dr. Mahmut Çerkez
Name of Assistant (s)	-
Mode of Delivery	Face to Face.
Language of Instruction	English
Prerequisites	-
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 basic 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:

- Model quantification, vertification, simplification, simulation and validation.
- Differences and possibilities of analytical and numerical models will be addressed.
- Attention will be paid to order of magnitude calculations and to the design and interpretaton of graphical representations of model simulations and eperiments, and especially to the biological significance of model and their relation with reality.

Learning Outcomes

At the end of the course the student should be able to		Assessment
1	Understand the benefits and pitfalls of mathematical modelling.	1,2
2	Design and analyse mathematical models of observed biological systems.	1, 2

3	Use existing computational tools for mathematical modelling.	1, 2
4	Analyse data obtained from complex biological systems.	1, 2
5	Perform parameter inference, model selection and evaluation	1, 2
6	Critically review theoretical systems biology research studies and new computational resources.	1, 2

Assessment Methods: 1. Written Exam, 2. Project/Report,

Course's Contribution to Program

		CL
1	Apply the rules of scientific research and ethics	5
2	Discuss complex biomedical engineering issues as well as own research results comprehensively and in the context of current international research and present these in writing and orally	5
3	Solve problems by systems analytical thinking both in subject specific and interdisciplinary concepts	5
4	Combine specialized knowledge of various component disciplines	4
5	Carry out in dependent scientific work and organize (capacity of teamwork), Conduct and lead more complex projects	5
6	To assess the social and environment-related effects of their actions	4

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

Course Contents

Week	Chapter	Topics	Assessment
1		Introduction to biochemical systems	
2		Conventions and calculations in biochemical systems Introduction to scientific programming with Python	
3		Chemical kinetics and transport processes Flow control: llops and Boolean operations	Assignment I
4		Enzyme-catalysed reactions: cycles, transients, and non-equilibrium steady-states Python data types and functions	

5		Biochemical signalling modules Python classes	
6		Biochemical reaction networks File I/O and error handling	
7		Coupled biochemical systems and membrane transport Plotting with Matplotlib	
8		Midterm	Midterm Exam
9		Stochastic biochemical systems and the chemical equation I	Assignment II
10		Stochastic biochemical systems and the chemical equation II Difference and differential equations	
11		No Lecture	
12		Spatially distributed systems and reaction-diffusion modelling I Random numbers and stochastic simulation	Assignment III
13		Spatially distributed systems and reaction-diffusion modelling I Partial differential equations	
14		Constraint-based analyses of biochemical systems Linear algebra	
15		Bio macromolecular structure and molecular association Demonstration: PyMOL	
16		Finals	Project submission and Presentations

Recommended Sources

Textbook:

1. Daniel A. Beard and Hong Qian. Chemical Biophysics: Quantitative Analyses of Cellular Systems. 2008. Cambridge University Press. ISBN: 978-0-521-87070-2

2. Darren j. Wilkinson. Stochastic Modelling for Systems Biology. 2006. Chapman & Hall/CRC Mathematical & Computational Biology. ISBN: 978-1-584-88540-5

1. Hans P. Langtangen. A Primer on Scientific Programming with Pythın. 2009. Springer-

Verlag. ISBN: 978-3-642-02474-0

Assessment

Project	50%	
Midterm Exam	30%	Written Exam
Coursework	%20%	
Total	100%	

Assessment Criteria

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

Course Policies

1. Attendance to the course is mandatory.
2. Late assignments will not be accepted unless an agreement is reached with the lecturer.
3. Students may use calculators during the exam.
4. 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	4	64
Labs and Tutorials	-	-	-
Assignment	-	-	-
Project/Presentation/Report	-	-	-
E-learning activities	-	-	-
Quizes	-	-	-
Midterm Examination	1	30	30
Final Examination	1	30	30
Self Study	14	8	112
Total Workload			236

Total Workload/25(h)	9.54
ECTS Credit of the Course	10