Course guide
820039 - MCSBB - Modelling and Control of Biomedical Systems

Last modified: 14/06/2023

Unit in charge:	Barcelona East School of Engineering
Teaching unit:	707 - ESAII - Department of Automatic Control.

Degree:	BACHELOR'S DEGREE IN BIOMEDICAL ENGINEERING (Syllabus 2009). (Optional subject).

Academic year: 2023   **ECTS Credits:** 6.0   **Languages:** English

LECTURER

Coordinating lecturer:	MARIA MONTSERRAT VALLVERDU FERRER
Others:	Segon quadrimestre:
	PEDRO GOMIS ROMAN - T10
	MARIA MONTSERRAT VALLVERDU FERRER - T10

PRIOR SKILLS

There are no prerequisites.

REQUIREMENTS

There are not

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Transversal:
1. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 3. Communicating clearly and efficiently in oral and written presentations. Adapting to audiences and communication aims by using suitable strategies and means.

TEACHING METHODOLOGY

The course uses participative lectures by 15%, the project-based learning by 35% and teamwork by 50%. Entire course will be held in a computer lab.

LEARNING OBJECTIVES OF THE SUBJECT

At the end of the course, the student will be able to:

· Analyze the behavior of a dynamical system; use software tools; design models to understand its performance; evaluate various strategies for its operation.

· Apply proper working methods of modeling biomedical systems, so that can be applied to solve problems in the field of biomedical engineering but also in general engineering.

STUDY LOAD

Type	Hours	Percentage
Hours large group	45,0	30.00
Hours small group	15,0	10.00
Self study	90,0	60.00

Total learning time: 150 h

CONTENTS

T1: Mathematical Modeling

Description:
Generalized system properties. Linear models of biomedical systems. Computer analysis and simulation using MATLAB and SIMULINK.

Related activities:
Lectures and laboratory work in computer lab room including guided projects.

Full-or-part-time: 30h
Theory classes: 7h 30m
Laboratory classes: 4h 30m
Self study : 18h

T2: Analysis of Biomedical Systems Using Linear Models

Description:
Steady-state analysis. Time-domain analysis. Frequency-domain analysis. Stability analysis.

Related activities:
Lectures and laboratory work in computer lab room including guided projects.

Full-or-part-time: 22h
Theory classes: 5h
Laboratory classes: 3h
Self study : 14h

T3: Identification of Biomedical Control Systems

Description:
Basic problems in biomedical system analysis. Identification methods. Parameter estimation. Identification of physiological systems.

Related activities:
Lectures and laboratory work in computer lab room including guided projects.

Full-or-part-time: 26h
Theory classes: 7h 30m
Laboratory classes: 4h 30m
Self study : 14h

T4: Optimization in Biomedical System Control

Description:
Application to models of biomedical systems: Optimization in systems with negative feedback; Single-parameter optimization; Constrained optimization.

Related activities:
Lectures and laboratory work in computer lab room including guided projects.

Full-or-part-time: 18h
Theory classes: 2h 30m
Laboratory classes: 1h 30m
Self study : 14h

T5: Nonlinear Analysis of Biomedical Control Systems: Complex Dynamics

Description:
Nonlinear versus linear systems. Nonlinear oscillators. Model of the cardiovascular variability. Model of the circadian rhythms.

Related activities:
Lectures and laboratory work in computer lab room including guided projects.

Full-or-part-time: 16h
Theory classes: 2h 30m
Laboratory classes: 1h 30m
Self study : 12h

T6: Application of modeling techniques to biomedical systems

Description:
Several models of biomedical systems will be developed in Matlab and Simulink. Tools of modeling and simulation will be applied. Various strategies for its operation will be evaluated.

Related activities:
Lectures and laboratory work in computer lab room including guided projects.

Full-or-part-time: 38h
Theory classes: 12h 30m
Laboratory classes: 7h 30m
Self study : 18h

GRADING SYSTEM

La evaluación se realizará mediante la valoración por parte del profesorado de las siguientes partes:

Entregables correspondientes a la parte de teoría (NLL): 30%
Prácticas de Laboratorio incluyendo los informes entregados de cada sesión (NLab): 30%
Trabajo final realizado en grupo (NTF): 35%
Evaluación de la competencia genérica (NCG): 5%

No habrá pruebas de exámenes parciales ni finales

Nota final= 0,3 NLL + 0,3 NLab + 0,35 NTF + 0,05 NCG

EXAMINATION RULES.

· In theory class, deliverables guided exercises will be developed, conducted individually or in groups of 2 students
· The lab will be assessed based on class attendance and delivery of practice reports. Practices can be individual or in groups of 2 students.
· The final work will take place individually or in groups of 2 students. Students may choose the final work with the advice and approval of the teacher. It will be presented orally with audiovisual support. Generic competence will be evaluated.

If it is not done any of the activities of the laboratory or deliverable of continuous assessment, it will be considered as not scored.

BIBLIOGRAPHY

Basic:
- Northrop, R. B. Endogenous and exogenous regulation and control of physiological systems. Boca Raton, FL [etc.]: Chapman & Hall/CRC, cop. 2000. ISBN 0849396948.
- Ljung, L. System identification : theory for the user. 2nd ed. Englewood Cliffs: Prentice-Hall, 1999. ISBN 0136566952.
- Solé Vicente, R.; Manrubia, S. C. Orden y caos en sistemas complejos. Barcelona: Edicions UPC, 2001. ISBN 8483014912.
- IEEE Transactions on Biomedical Engineering [on line]. New York, NY: Antennas and Propagation Society of the Institute of Electrical and Electronics Engineers, 1988- [Consultation: 02/06/2020]. Available on: http://ieeexplore.ieee.org/servlet/opac?punumber=10.- IEEE Pulse [on line]. New York: Institute of Electrical and Electronics Engineers, 2010- [Consultation: 02/06/2020]. Available on: http://ieeexplore.ieee.org/xpl/RecentIssue.jsp?punumber=5454060.- Medical & biological engineering & computing [on line]. Berlin: Springer, 1963- [Consultation: 02/06/2020]. Available on: http://www.springerlink.com/content/1741-0444/?sortorder=asc&p_o=234.- European journal of applied physiology [on line]. Berlin: Springer-Verlag, [2000]- [Consultation: 02/06/2020]. Available on: http://www.springerlink.com/openurl.asp?genre=journal&issn=1439-6319.- Medical engineering & physics [on line]. New York, NY: Elsevier Science Pub. Co., [19??]- [Consultation: 02/06/2020]. Available on: http://www.sciencedirect.com/science/journal/13504533.