69316 - Models and systems of physiological control

Información del Plan Docente

Academic Year	2017/18
Faculty / School	110 - Escuela de Ingeniería y Arquitectura
Degree	547 - Master's in Biomedical Engineering
ECTS	3.0
Year	1
Semester	Second semester
Subject Type	Optional
Module	---

1.General information

1.1.Introduction

1.2.Recommendations to take this course

1.3.Context and importance of this course in the degree

1.4.Activities and key dates

2.Learning goals

2.1.Learning goals

2.2.Importance of learning goals

3.Aims of the course and competences

3.1.Aims of the course

3.2.Competences

4.Assessment (1st and 2nd call)

4.1.Assessment tasks (description of tasks, marking system and assessment criteria)

5.Methodology, learning tasks, syllabus and resources

5.1.Methodological overview

The methodology followed in this course is oriented towards achievement of the learning objectives. A wide range of teaching and learning tasks are implemented, such as

- **A01 Lectures** (15 hours). Presentation of the main contents of the course by the teacher. This activity will take place in the classroom.
- **A02 Practice sessions** (7 hours). Problem-solving and Case Studies done individually or in group.

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- **A03 Laboratory Practice sessions** (4 hours). Laboratory Practices are divided in: 1) Acquisition and registration of biomedical signals at the Laboratory. 2) Study and characterization of the Cardiovascular System Control. These sessions are assessed by reports and the students' attitude in the laboratory (see the previous Section Assessment tasks).
- **A05 Assignments**. The students will solve individually case studies stated by the teacher. If the case is complex, the activity could be done in groups as established by the teacher. This activity will be evaluated in accordance with the information of the Section Assessment tasks.
- **A06 Tutorials**. Students can review and discuss materials and topics presented in the theoretical and practical classes during the teacher's office hours.
- **A08 Assessment**. A set of written tests of theoretical and practice aspects, reports and assignments proposed for evaluation (see the previous Section Assessment tasks).

5.2.Learning tasks

The course will address the following topics:

1. Physiological Dynamical systems modeling
2. Physiological Dynamical systems analysis
3. Feedback systems
4. Control of physiological systems
5. System Identification
6. Control of physiological systems
7. Physiological devices control
8. Models, diagnostic and therapeutic applications

5.3.Syllabus

The course will address the following topics:

Topic 1. Basic Concepts of modeling and control of systems.

- 1.1 Signals and Systems. Basic concepts of signals and systems. Types of systems. Dynamical systems. Physiological systems. Simulation.
- 1.2 Modeling of dynamic systems. Modeling physical systems. Models of differential equations. Transfer Function models. Block diagrams. Poles and zeros of a system. Analogies. Nonlinear systems. Linearization. Examples of physiological system modeling.
- 1.3 Temporal analysis of dynamical systems. Stability concept. Criteria for the stability analysis of dynamical systems. Transient and steady-state behaviors. First order systems. Second-order systems. Higher order systems. Pure delay. Stability. Feedback. Examples of temporal analysis of physiological systems.
- 1.4 Analysis in the frequency domain. Fourier transform. Frequencial description. Frequency transfer function. Bode diagrams. Examples of frequency analysis of physiological systems. Identification.
- 1.5 Concepts and techniques of control. Basic feedback control systems. Control actions. Types of drivers. Controller tuning methods. Control Examples of physiological systems.

Topic 2. Physiological Systems and Applications

- 2.1 Cardiovascular control system
  - 2.1.1 Model for cardiac output regulation
  - 2.1.2 Representations and models for heart rate regulation
  - 2.1.3 Modeling and regulation of blood pressure
  - 2.1.4 Models for cardiovascular control
- 2.2 Respiratory control system
  - 2.2.1 Regulation of respiration
  - 2.2.2 Periodic breathing and obstructive sleep apnea

5.4.Course planning and calendar

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Further information concerning the timetable, classroom, office hours, assessment dates and other details regarding this course, will be provided on the first day of class or please refer to the EINA website.

5.5.Bibliography and recommended resources

- **BB** Craig, John J.. Introduction to robotics : mechanics and control / John J. Craig . - 2nd ed. Reading, Massachusetts : Addison-Wesley, cop. 1989
- **BB** Fundamentos de robótica / Antonio Barrientos ... [et al.]. - 2ª ed. Madrid [etc.] : McGraw-Hill, cop. 2007
- **BB** Pons, José L. Wearable robots: biomechatronics exoskeletons / J.L. Pons. Chichester : Wiley, 2008
- **BC** Dudek, Gregory. Computational principles of mobile robotics / Gregory Dudek, Michael Jenkin . - 2nd ed. New York: Cambridge University Press, 2010
- **BC** Medical robotics / edited by Vanja Bozovic. Viena : I-Tech EDucation and Publishing, 2008

Software and equipment to be used:

- Software: Matlab - Simulink
- Biosignal processing equipment