

Academic Year/course: 2022/23

## 69716 - Models and systems of physiological control

### Syllabus Information

**Academic Year:** 2022/23

**Subject:** 69716 - Models and systems of physiological control

**Faculty / School:** 110 - Escuela de Ingeniería y Arquitectura

**Degree:** 633 - Master's Degree in Biomedical Engineering

**ECTS:** 3.0

**Year:** 1

**Semester:** Second semester

**Subject Type:** Optional

**Module:**

### 1. General information

### 2. Learning goals

### 3. Assessment (1st and 2nd call)

### 4. Methodology, learning tasks, syllabus and resources

#### 4.1. Methodological overview

The methodology followed in this course is oriented towards the achievement of the learning objectives. A wide range of teaching and learning tasks are implemented, such as: lectures, problems and practices, with increasing level of student participation.

- In the lectures, the teachers will present the theoretical bases of modelling, analysis and control of physiological systems, illustrated with examples.

- In the classes of problems, the students will develop problems and exercises stated.

#### 4.2. Learning tasks

The learning process that is designed for this course is based on the following:

- A01 Participatory master class (15 hours). Presentation of the main contents of the subject by the teacher. This activity will take place in the classroom in person.
- A02 Problem resolution and case study (6 hours). Problems and Case Studies resolution individually or in group.
- A03 Labs (9 hours). Laboratory practices will be performed with the available equipment. The student must perform a preliminary study prior to conducting the practice in the laboratory, develop the proposal during the session practical activity, and perform a brief report on the results obtained. All these activities in accordance with the provisions of section Assessment will be evaluated.
- A06 Tutoring (12 hours). Personalized service to review and discuss materials and themes presented in the theoretical and practical classes.
- A07 Study (60 horas). Personal work of the student theoretical part, conducting exercises, preparation of oral presentations, and development of practical individual or group work.
- A08 Evaluation (3 hours). Set of written tests of theoretical and practice aspects, reports and works proposed for evaluation. Details in the evaluation section.

### 4.3. Syllabus

#### 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. Frequency 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.

#### 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

### 4.4. Course planning and calendar

Scheduling and presentation of works:

The schedule of the course, both the sessions in the classroom and the laboratory sessions, will be determined by the academic calendar that the Center established for the corresponding course. The schedule for submission of papers shall be announced at the beginning of the course.

### 4.5. Bibliography and recommended resources

Software y equipment:

- Software: Matlab-Simulink
- Equipment for biosignal processing

[http://biblos.unizar.es/br/br\\_citas.php?codigo=69316&year=2019](http://biblos.unizar.es/br/br_citas.php?codigo=69316&year=2019)