Universidad Zaragoza

Academic Year/course: 2024/25

69716 - Models and systems of physiological control

Syllabus Information

Academic year: 2024/25
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

The first part of the subject will review the fundamentals of modelling dynamic systems by means of differential equations and the transfer function. The basic techniques for the analysis of dynamical systems based on the models presented will be discussed: first, second and higher order systems, and the place of the roots. Subsequently, control techniques for dynamic systems are studied. These aspects will be applied to simple models of different physiological systems. In the second part, the above techniques will be applied to several real case studies with more complex models, mainly to the cardiovascular and respiratory systems. The above techniques will be studied with the support of simulation, analysis and design tools for dynamic systems.

2. Learning results

- To be able to build simple models of physiological systems (cardiovascular, respiratory, musculoskeletal, autonomic nervous, glucose-insulin, artificial pancreas).
- To be able to analyse them with the general techniques of continuous systems analysis, relating their behaviour to the specific physiological system in question and to possible pathologies.
- To be able to interpret the influence of the variation of model parameters and relate it to the real physiological system´s behaviour variation.
- To be able to design simple artificial controllers for physiological parameter control.
- To be able to simulate simple models of physiological systems.
- To be able to understand and analyse the physiological control mechanisms of the body and relate them to learned system control mechanisms.
- To be able to understand the functioning and necessity of the control mechanisms that regulate the body's internal homeostasis in the face of certain perturbations.

3. Syllabus

1.Basic concepts of systems modelling and control.

- 1.1 Basic concepts of signals and systems. Dynamic and physiological systems.
- 1.2 Modelling of dynamic systems. Transfer function. Block diagrams. Analogies, linearization. Examples.
- 1.3 Time domain analysis of dynamical systems. Transitory regime and permanent regime. Stability. Examples.
- 1.4 Frequency domain analysis. Frequency transfer function. Bode diagrams. Examples.
- 1.5 Basic control concepts and techniques. Examples.

Physiological systems and applications.

- 2.1 Cardiovascular control system. Model for the regulation of cardiac output, heart rate and blood pressure.
- 2.2 Respiratory control system. Aplication to the modeling of obstructive sleep apnoea.

4. Academic activities

Lectures: sessions where the professor will explain the subject´s topics: 15 hours.

Problems and cases: sessions to solve exercises and practical cases proposed by the teacher: 6 hours

Laboratory practice: practical sessions in the laboratory: 9 hours

Study of the subject, assignments: 42 hours

Assessment tests: 3 hours

This course is English Language Friendly, which means that: the course syllabus is also available in English; the study and/or class materials are in English; the faculty is willing to conduct office hours in English; and students are allowed to take their assessments in English

5. Assessment system

-**Exam**(30% of the grade, minimum 5 out of 10).

-**Assignments and evaluable activities** (30% of the grade). The evaluation of the work will be based on the report submitted.

-**Laboratory practices** (30% of the grade). The assessment of the practical sessions will be done through the reports presented, as well as the work done in the laboratory.

-**Oral presentations**(10% of the grade). Presentation of results of work and practical exercises and answering questions about them.

In order to pass the subject, the **4 evaluation activities** must be completed.

-**Global test** (official examinations, 100% of the grade, minimum 5 out of 10). The overall test includes:

-**Exam** (40% of the grade, minimum 5 out of 10). It will contain questions related to theoretical contents, case studies and laboratory practices.

-**Assignments and evaluable activities** (30% of the grade). The evaluation of the work will be based on the report submitted.

-**Laboratory practices** (30% of the grade). The evaluation of the practical sessions will be based on the report submitted.

6. Sustainable Development Goals

3 - Good Health & Well-Being
9 - Industry, Innovation and Infrastructure