## Automatique

#### Lecturer

Michel KINNAERT (Coordinator)

Course mnemonic MATH-H304

ECTS credits 5 credits

Language(s) of instruction French

**Course period** Second term

### Course content

Introduction and motivation Part I: Modelling of dynamic systems

- > Dynamic model: refresher, linearization, introduction to state space models
- > Sudy of the state space models
- > Analysis of the model of a LTI system: characterization of the time resonse, link with the pole positions
- > Modelling from experimental data

Part 2: Foundations of control loops

- > Analysis of the properties of a closed-loop
- > Basic notions on PID control

Part 3: Controller design

- > Root locus method
- > Methods based on the harmonic response
- > Introduction to digital control

# Objectives (and/or specific learning outcomes)

The objective is to teach the foundation of control engineering. At the end of the course, the student will be able

- > to determine and use different types of modesl for singlleinput-single-output linear time invariant dynamic systems (transfer function, state space model)
- > to analyse the preperties of linear time invariant (LTI) dynamic systems (stability, controllability, observability)
- > to synthesize a classicla controller (P, PI, PID, lead or lag controller) be exploiting the root locus method and/or

methods based on the harmonic response (Bode and Nyquist curves)

### Pre-requisits and co-requisits

Pre-requisites courses

MATH-H2000 | Analyse II | 8 crédits

#### Co-requisites courses

MECA-H3001 | Fluid mechanics and transfer processes | 5 crédits

## Teaching method and learning activities

- > Lectures based on slides and numerous examples detailed on the blackboard
- > Practical work

#### Contribution to the teaching profile

This teaching unit contributes to the following competences:

- Abstraire, modéliser et simuler des systèmes physiques complexes rencontrés dans les applications biomédicales (bioélectricité, biomécanique, écoulements, etc.)
- Se représenter les mécanismes biologiques fondamentaux depuis la biochimie de la cellule jusqu'au fonctionnement des principaux systèmes de la physiologie humaine

## References, bibliography and recommended reading

G.F. Franklin, J.D. Powell and A. Emami-Naeini. Feedback Control of Dynamic Systems. 7th edition, Peasron, 2015

K. Ogata. ModernControl Engineering, 5th edition, Prentice Hall, 2010.

## Evaluation method(s)

Other

#### Evaluation method(s) (additional information)

Practical work: evlautaion of the reports and student activity 1st sessions: Written and oral exams 2nd session: written examn only

Determination of the mark (including the weighting of partial marks)

First session: practical work 20%, written exam 40%, oral exam 40%  $\!\!$ 

Second session: practical work 20%, written exam 80%

MATH-H304 | 2024-2025

## Main language(s) of evaluation French

## Programmes

### Programmes proposing this course at the Brussels School of Engineering

BA-IRCI | Bachelor in Engineering Sciences | option Bruxelles/ unit 3, MA-IRBC | Master in Chemistry and Bio-industries Bioengineering | finalité Professional/unit 1 and MA-IRBE | Master in Environmental Bioengineering | finalité Professional/unit 1

## Programmes proposing this course at the faculty of Sciences

MA-IRBC | Master in Chemistry and Bio-industries Bioengineering | finalité Professional/unit 1 and MA-IRBE | Master in Environmental Bioengineering | finalité Professional/unit 1