UNIVERSITEIT GENT

Studiefiche

Academiejaar 2023-2024

Introduction to Mathematical Modelling (I002891)

Cursusomvang *(nominale waarden; effectieve waarden kunnen verschillen per opleiding)*

Studiepunten 6.0 **Studietijd 180 u**

Aanbodsessies in academiejaar 2023-2024

A (semester 1) Engels Gent

Lesgevers in academiejaar 2023-2024

Van Liedekerke, Paul LA26 Verantwoordelijk lesgever

Aangeboden in onderstaande opleidingen in 2023-2024	stptn	aanbodsessie
Master of Science in Pharmaceutical Engineering	6	A

Onderwijstalen

Engels

Trefwoorden

Calculus, differential equations, uncertainty quantification, dynamic system analysis

Situering

This course provides a basis for the formulation and usage of mathematical models necessary for simulations of pharmaceutical processes. These models heavily draw on differential equations and concepts from calculus.
In the first part the students are acquainted with basic mathematical techniques and methods that are required to understand, analyse and describe various production processes. Such a mathematical background is needed in preparation for building and simulation of process models. Subsequently, students are familiarized with systems of differential equations and (non-)linear differential equations, and introduced to analytical and numerical solution methods to be able to predict processes
In the second part of the course, students will learn how to deal with modeling uncertainty and probability.
In the third part, the students will learn how to perform a sensitiviy analysis and parameter estimation of the models, as well as how to decide how "good" a model is.

Inhoud

1. Functions of one variable: continuity, derivatives, Taylor series, Integration
2. Linearization of functions, root finding
4. Vectors and Matrices, eigenvalues
5. Functions of several variables: derivatives, Taylor series, gradient, Hessian
7. Introduction to differential equations
8. Qualitative analysis of 1st order diff eqns
9. Solving 1st order diff eqns numerically
10. Systems of diff eqns and higher order diff eqns
11. Laplace transformations
12. Mass balance equations and diffusion effects
13. Probabilistic modeling and stochastic simulations
14. Sensitivity analysis
15. Parameter estimation, Model evaluation, Model selection

Begincompetenties

Knowledge of basic mathematics : derivatives, integrals, matrix algebra, vectors.

Eindcompetenties

1 To understand the mathematical and geometric meaning of functions of one and more variables
2 To understand the mathematica land geometric meaning of polar coordinates, parametric functions, vector functions and vector fields.
3 To be able to use functions of multiple variables, polar coordinates, parametric functions, vector functions and vector fields
4 To build, follow and execute correct reasoning for functions of one and more variables.
5 To be able to work with functions of one and more variables in a correct and mathematically precise manner.
6 To be able to recognise diverse types of differential equations.
7 To be able to apply analytical solution techniques.
8 To be able to execute qualitative analyses of (sets of) differential equations.

9 To be able to use numerical solution methods for differential equations in pyhton.
10 To be able to translate a system description into a mathematical model as a set of differential equations
11 Be able to make the link between model results and physical reality.

12 Quantify and compare the sensitivity of model attributes.
13 Conduct a parameter estimation and quantify its reliability.

Creditcontractvoorwaarde

Toelating tot dit opleidingsonderdeel via creditcontract is mogelijk na gunstige beoordeling van de competenties

Examencontractvoorwaarde

Dit opleidingsonderdeel kan niet via examencontract gevolgd worden

Didactische werkvormen

Werkcollege, Hoorcollege, Zelfstandig werk

Toelichtingen bij de didactische werkvormen

Theory in plenary lectures, exercises in PC-practicals

Leermateriaal

Syllabi are available for both theory and exercises. Slides of theoretical lectures and practical exercises are available in Ufora

Referenties

Adams, R.A. and Essex, C. Calculus 9th edition (2009). Pearson

P. Vanrolleghem & D. Dochain Bioprocess Model Identification. In: Advanced Instrumentation, Data Interpretation and Control of Biotechnological Processes. Eds. Van Impe J., Vanrolleghem P., Iserentant D., Kluwer (1998).

B.A. Oggunaike & W.H. Ray Process Dynamics, Modeling and Control. Oxford University Press (1994). L. Ljung System Identification - Theory for the User. Prentice-Hall (1999).

Trench, W.F., Elementary differential equations, Brooks/Cole Thomson Learning, 2001;
Boyce, W.E., DiPrima, R.C., Meade, D.B., Elementary Differential Equations and Boundary Value Problems, Wiley, 2017.

Vakinhoudelijke studiebegeleiding

Study coaching is offered before and after each of the oral lectures and practicum or after appointment. There is also a forum on Ufora

Evaluatiemomenten

periodegebonden evaluatie

Evaluatievormen bij periodegebonden evaluatie in de eerste examenperiode

Schriftelijke evaluatie met meerkeuzevragen, Schriftelijke evaluatie

Evaluatievormen bij periodegebonden evaluatie in de tweede examenperiode

Schriftelijke evaluatie met meerkeuzevragen, Schriftelijke evaluatie

Evaluatievormen bij niet-periodegebonden evaluatie

Presentatie, Werkstuk

Tweede examenkans in geval van niet-periodegebonden evaluatie

Examen in de tweede examenperiode is niet mogelijk

Toelichtingen bij de evaluatievormen

--- Klik om te editeren ---
Open book exam
Solving problems on computer

Eindscoreberekening

Calculus (25%), differential eqns (30%), probability and uncertainty (15%), dynamic system analysis (30%)