



## COURSE SYLLABUS

# Doctoral course: Mathematics for Doctoral Economics II, 7,5 credit points

---

Course code:  
Reviewed by: RFB  
Approved by: RFB  
Valid as of: 2019-06-12  
Version: I  
Reference number:

Education Cycle: Third cycle, doctoral program course  
Doctoral programme subject: Economics

---

### Purpose:

The *Mathematics for Doctoral Economics II* course is designed to help students be prepared for the mathematical material on dynamic equations that is typically found in the economics (especially macroeconomics) and statistics courses associated with doctoral programme in economics.

### Intended learning outcomes:

On completion of the course, the students will be able to:

#### *Knowledge and understanding*

1. indicate economic or statistics information that is transmitted by mathematical derivations covered in this course.

#### *Skills and abilities*

2. determine the equilibria and the out-of-equilibrium properties for linear and nonlinear first-order dynamic univariate equations and for linear higher-order dynamic equations.
3. determine the equilibrium for a first-order linear dynamical system, whether that equilibrium is stable or unstable, and how the dynamical system behaves when not in equilibrium.
4. find the solution to a dynamical system, or to a higher-order dynamic univariate equation.
5. perform dynamic optimization.

#### *Judgement and approach*

6. carry out mathematical derivations within the mathematical material covered with sufficient thoroughness to avoid largely unnecessary mistakes given time constraints.

### Content:

The contents of this course include

- (i) dynamic univariate equations (difference equations and differential equations), including higher-order linear dynamic equations and first-order nonlinear dynamic equations.
- (ii) phase diagrams
- (iii) stochastic processes.
- (iv) chaos theory.
- (v) linear dynamical systems, including those with spiraling behavior when not in equilibrium.
- (vi) dynamic optimization: calculus of variations, optimal control theory, and dynamic programming.

**Type of Instruction/Teaching format:**

Lectures and homework assignments.

**Prerequisites:**

Admitted to a doctoral programme in economics or a related subject of a recognized business school or university.

**Examination and grades:**

The examination consists of three written examinations, with their percentage contributions to the final overall grade noted in parentheses below:

- Midterm examination (40%), which covers ILOs 1, 2, 3, 4, 6
- Final examination (60%), which covers ILOs 1, 3, 4, 5, 6

To pass the course the student needs to achieve at least 60% correct of the maximum possible points on the final overall grade and at least 50% correct on the final examination.

**Course evaluation:**

A course evaluation will be conducted at the end of the course.

**Additional information:**

The course language is English.

**Literature:**

The primary textbook is Chiang, Alpha C. and Wainwright, Kevin C. (2005) *Fundamental Methods of Mathematical Economics 4th edition*, McGraw Hill [ISBN: 007-123823-9]

The course also uses material from Sydsaeter, K., Hammond, P., Seierstad, A. and A. Strom (2008) *Further Mathematics for Economic Analysis*, 2<sup>nd</sup> ed, Pearson [ISBN: 978-0-273-71328-9], including chapters 8 and 12.

Supplementary material may also be assigned.