Faculty of Health, Science and Technology
Mathematics

Syllabus

Mean Field Games: Theory and Applications

Course Code: 7MAT007
Course Title: *Mean Field Games: Theory and Applications*
Mean Field Games: Teori och tillämpningar
Subject: Mathematics
Credits: 7.5 ECTS
Degree Level: Doctoral

Course Approval
The syllabus was approved by the Faculty of Health, Science and Technology,
22 March 2023 and is valid from the spring semester 2023.

Language of instruction
Teaching is in English.

Prerequisites
The course is primarily for PhD students in mathematics at Karlstad University,
secondly for PhD students admitted to other universities, and thirdly for other
students with equivalent knowledge.

Learning Outcomes
Upon completion of the course, doctoral students should be able to:
- demonstrate familiarity with what a mean field game is, in particular, what a
  mean filed game means from a modelling point of view,
- demonstrate familiarity with the mathematical analysis techniques involved in
  proving its well-posedness (particularly, with the handling of Fokker-Planck
  equations and of Hamilton-Jacobi equations and of combinations thereof),
- derive mean field game structures starting off from control problems posed at
  the level of discrete or stochastic populations of agents, and
- construct numerical approximations of mean field games.

Course Content
The course is based on an individual study of the course literature on mean field games and related materials. The course includes scientific discussions with the supervisor(s) and with other colleagues.

Reading List
See separate document.

Examination
For a Pass grade, doctoral students are required to study the course literature, work out an individual project and write down the corresponding report, and discuss the content of the course with the supervisor(s). Additionally, the doctoral students are required to deliver at least one research seminar connected to the mean field topic.

Grades
One of the grades Fail (U) or Pass (G) is awarded in the examination of the course.

Quality Assurance
The course convenor has a duty to encourage a continuous dialogue on learning processes and goal fulfilment. A written evaluation is carried out at the conclusion of the course combined with a joint student-teacher discussion of all aspects commented on. The result of the evaluation is collated and made available in accordance with *The Higher Education* Ordinance, Chapter 1, § 14.

Course Certificate
Course certificate is issued on request.

Goal matrix

Goals that, after completing the course, are fulfilled for the doctoral or licentiate degree are marked with an X.

	Doctoral			Licentiate	
	Knowledge and understanding			**Knowledge and understanding**	
1a	- demonstrate broad knowledge and systematic understanding of the research field and	x	1a	demonstrate knowledge and understanding in the field of research including	x
1b	advanced and up-to-date specialised knowledge in a limited area of this field, and	x	1b	current specialist knowledge in a limited area of this field as well as	x
1c	familiarity with research methodology in general and the methods of the specific field of research in particular.		1c	specialised knowledge of research methodology in general and the methods of the specific field of research in particular	
	Competence and skills			**Competence and skills**	
2a	- demonstrate capacity for scholarly analysis and synthesis as well as		2a	demonstrate the ability to identify and formulate issues with scholarly precision critically, autonomously and creatively and to	
2b	to review and assess new and complex phenomena, issues and situations autonomously and critically		2b	plan and use appropriate methods to undertake a limited piece of research and other qualified tasks within predetermined time frames in order to contribute to the formation of knowledge	x
3a	- demonstrate the ability to identify and formulate issues with scholarly precision critically, autonomously and creatively, and to	x	2c	as well as to evaluate this work	
3b	plan and use appropriate methods to undertake research and other qualified tasks within predetermined time frames and to review and evaluate such work		3a	demonstrate the ability in both national and international contexts to present and discuss research and research findings in speech and writing and in dialogue with the academic community and	
4	- demonstrate through a dissertation the ability to make a significant contribution to the formation of knowledge through his or her own research		3b	society in general	

5a	- demonstrate the ability in both national and international contexts to present and discuss research and research findings authoritatively in speech and writing and in dialogue with the academic community and		4	demonstrate the skills required to participate autonomously in research and development work and to work autonomously in some other qualified capacity.	
5b	society in general				
6	- demonstrate the ability to identify the need for further knowledge and				
7	- demonstrate the capacity to contribute to social development and support the learning of others both through research and education and in some other qualified professional capacity.				
	Judgement and approach			**Judgement and approach**	
8a	- demonstrate intellectual autonomy and disciplinary rectitude as well as		5	demonstrate the ability to make assessments of ethical aspects of his or her own research	
8b	the ability to make assessments of research ethics, and		6	demonstrate insight into the possibilities and limitations of research, its role in society and the responsibility of the individual for how it is used	
9	- demonstrate specialised insight into the possibilities and limitations of research, its role in society and the responsibility of the individual for how it is used.		7	demonstrate the ability to identify the personal need for further knowledge and take responsibility for his or her ongoing learning.	