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Appendices for the Master's degree programme(s) in Systems and Control

2024-2025

Appendix I Learning outcomes of the degree programme (art. 3.1)

Objectives of MSc Systems and Control

With a master's degree in Systems and Control, students are trained to use interdisciplinary strategies to control complex systems and processes. The techniques used include modelling, dynamic data analysis, dynamic systems theory, control theory, optimization and network analysis. This master's programme has a focus in 'Complex Systems and Networks'. The most challenging problems in today's engineering systems have to do with systems that consist of many components that influence each other and whose structure and dynamics are very complex and difficult to control. Examples are our electricity network with many energy producing and summing units; billions of people on social media; or billions of neurons in the human brain. In these complex systems, each individual component interacts (physically or via digital information) with a portion of all other components with the pattern of connections defining the network. The students in this master programme will learn the underlying theory to analyze and control complex systems, in a way that provides provable guarantees for the regulated behavior of the system. They learn to use this theory in a critical way in a series of applications, whereby the understanding of the methods used is paramount.

The above objective has been translated into a set of learning outcomes for the programme.

Knowledge and Understanding
The master graduate in Systems and Control:
1.1 Has profound knowledge of the generic concepts of Systems and Control, including the necessary mathematics and engineering concepts, its relevance in technology, and computational aspects, at a level which permits admission to a higher level post-graduate programme
1.2 Has understanding of the disciplines that are relevant to the field of Systems and Control (such as electrical and mechanical engineering, robotics, physics) at a level which permits admission to a higher level post-graduate programme
1.3 Has operational knowledge and design/development skills in the field of Systems and Control

Application of Knowledge and Understanding
In addition, the master graduate in Systems and Control:
2.1 Has critical awareness and is capable of performing analysis, design, modeling and simulations within the context of complex engineering problems and networks, using methods from the field of systems and control
2.2 Is capable of applying his/her in-depth knowledge and practical skills to solve complex problems with respect to technological dynamical systems taking into consideration their external interaction with the environment as well as the internal interactions between their subsystems
2.3 Is capable of carrying out research at academic level, aimed at identifying, formulating and solving complex problems within the field of systems and control
2.4 Is capable of developing and designing new methods, algorithms and control strategies using specific knowledge from the field of system and control while optimizing processes and resources
2.5 Is capable of analyzing data relevant to control systems and networks and retrieve information from the literature and other sources of information
2.6 Is capable to write scientific reports
2.7 Has developed an attitude aimed at seeking new innovative applications
2.8 Has experience in the application of systems and control in an industrial environment or in a research environment abroad
2.9 Is capable of collaborating in a (multi-disciplinary) research and design team

Judgement

In addition, the master graduate in Systems and Control:

3.1 Is capable of judging his/her and others' actions within a scientific context, taking economic, societal and ethical aspects into account
3.2 Is able to act in a responsible manner in regards to sustainability, economy and social welfare
3.3 Is able to draw conclusions on the basis of limited or incomplete information, and is able to realize and formulate the limitations of such conclusions
3.4 Is capable of working independently as well as part of a team to solve technological problems
3.5 Is able to explain scientific information and defend scientific outcomes within his/her research field

Communication Skills

In addition, the master graduate in Systems and Control:

4.1 Is capable of communicating in the English language, clearly and effectively, verbally and in writing, on his/her subject and relevant applications, at a level which is understandable to experts and non-experts
4.2 Is able to communicate scientifically with experts from different disciplines
4.3 Is capable of using modern communication tools

Learning Skills

In addition, the master graduate in Systems and Control:

5.1 Is capable of addressing issues inside as well as outside his/her main subject area, and thereby gaining new knowledge and skills
5.2 Is able to recognize potential systems and control applications in recent advances in science and technology
5.3 Has the ability to learn independently and engage in life-long learning

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Appendix II Tracks/Specializations of the degree programme (art. 3.6)

The Master's degree programme Systems and Control has one specialization: Complex Systems and Networks

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Appendix III Content of the degree programme (art. 3.8)

In the first year the programme consists of 5 compulsory courses (see list below) covering 25 ECTS and electives (see Appendix IV) covering 35 ECTS. In the second year the Internship/Design Project (20 ECTS) and Master Research Project (40 ECTS) takes place. Course details, mode of assessment and examinations are described on Ocasys.

Compulsory courses		
Course Unit	**Course Code**	**ECTS**
Advanced Systems and Control	WMSC001-05	5
Robust control	WMMA021-05	5
Fitting dynamical models to data	WMIE007-05	5
Nonlinear Control Systems	WMSC003-05	5
Integration project	WMSC002-05	5
Internship/Design Project	WMSC901-20	20
Research Project	WMSC902-40	40

Possibility of double master degrees

It is possible to study the MSc Systems & Control in parallel to other master programmes. Individual courses can then count for both programmes, however in order to obtain two degrees at least 180 distinct ECTS have to be obtained. Furthermore, an internship/design project as well as a master research project can only be used for one of the degree programmes, unless the board of examiners agrees on individual rules (such as replacing the individual project by a joint project) or there are specific regulations mentioned below.

- Double master MSc Systems & Control with MSc Industrial Engineering and Management (IEM)

  It is possible to replace the individual internship/design projects and research projects by joint projects, see the specific regulations in the corresponding TER for IEM

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Appendix IV Electives (art. 3.9.1)

In addition to the compulsory courses students have to follow 35 ECTS of electives which have to be chosen from the list below. Other electives which are in line with the learning outcomes can be taken if individually approved by the Board of Examiners.

Course details, mode of assessment and examination are described on Ocasys.

Course Unit	Course Code	ECTS
Advanced Vibrations	WMME030-05	5
Analysis and Control of Smart Systems	WMIE015-05	5
Calculus of Variations and Optimal Control (25/26)	WMMA056-05	5
CFD for Engineers	WMCE013-05	5
Compressible Flows	WMCE008-05	5
Data-based Analysis and Control (25/26)	WMMA058-05	5
Data-driven Optimization	WMME011-05	5
Finite Elements Methods and Applications	WMMA051-05	5
Game Theory with Engineering Applications	WMIE009-05	5
Introduction to Data Science	WMME027-05	5
Introduction to Stochastic Programming	WMIE019-05	5
Model Reduction for Control (24/25)	WMMA062-05	5
Multibody and Non-Linear Dynamics	WMME009-05	5
Optimization in Engineering Systems	WMIE026-05	5
Opto-mechatronics	WMME015-05	5
Robotics for IEM	WMIE005-05	5
Systems and Control (Mastermath)	WMMA003-06	6
Systems Engineering	WMIE021-05	5

Appendix V Entry requirements and compulsory order of examinations

(art. 4.4)

A student is allowed to start with either the Design or Research project if the below prerequisites are met:

- Completed at least 35 ECTS worth of study elements from the first year
- Enrolment in Progress for the design or research project course
- Approval of research plan including project schedule by supervisors and Master Project coordinator
- Completion of the Scientific Integrity course (WMME004-00)

Appendix VI Admission to the degree programme (art. 2.1A.1 + 2.1B.1)

Holders of the following Bachelor's degrees from the University of Groningen will directly be admitted to the Master's degree programme:

- (Applied) Mathematics
- Astronomy (Track: Informatics and Instrumentation)
- Industrial Engineering and Management
- Chemical Engineering

Holders of the following Bachelor's degrees from universities in the Netherlands will directly be admitted to the Master's degree programme:

- Aerospace Engineering
- Mechanical Engineering
- Electrical Engineering

Holders of a comparable diploma (as determined by the admission committee) from other universities are also admissible. They may request an individual admission decision. Students that enter the master's degree programme in Systems and Control should have sufficient knowledge of mathematics, basic control theory and engineering, as well as a minimal level of English.

The minimal English requirements are as follows:
- IELTS (Academic) – 6.5, no less than 6.5 on each section
- TOEFL IBT (internet based test) – 90
- Cambridge English – CAE or CPE certificate with a minimum score of 180

Note that students holding a baccalaureate diploma with English as the medium of instruction are exempted to prove the above English requirements.

Holders of an HBO degree from the Netherlands do not have direct access to Master programmes and need to complete a pre-master programme.

Appendix VII Transitional provisions (art. 7.1)

The transitional arrangement is an arrangement that students can use if they wish to replace a course that is part of their Teaching and Examination Regulations, but either no longer exists or has been changed to a different course in a later set of Teaching and Examination Regulations. In some cases, an arrangement can consist of multiple courses. If a transition is not in the list of transitional arrangements, students will need permission of the Board of Examiners first.

For cohort 2023-2024 and earlier

The names of the following courses have been changed and hence are considered equivalent. Therefore, students are not allowed to include both the old and new course in their programme.

Old course	**New Course**
Modeling and Identification (WMMA007-05)	Model Reduction for Control (24/25) (WMMA062-05)
Modelling and Control of Complex Nonlinear Engineering Systems (WMMA020-05)	Nonlinear Control Systems (WMSC003-05)
Web and Cloud Computing (WMCS005-05)	Cloud Computing and Cloud-based Applications (WMCS032-05)

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Appendix VIII Additional Requirements Open Degree Programmes (Art. 3.10)

In exceptional circumstances students wishing to pursue an open degree programme may file a request with the Board of Examiners. The Board of Examiners will evaluate whether the proposed curriculum meets the learning outcomes of the degree programme and can determine further conditions in their Rules and Regulations.