Conversion Table Systems & Control => MSc Robotics

Introduction

When you want to keep the option open to later step over from MSc Systems & Control to MSc Robotics, choosing your elective courses in Systems & Control is important, as otherwise not all courses of the S&C programme can be used in the MSc Robotics programme.

Note the following:

1. While complying with the rules of MSc Systems & Control, you can always stay in MSc Systems & Control, as that programme stays alive at least 3 years after the last student enrols.
2. Stepping over to MSc Robotics or staying in MSc Systems & Control, it is your *own* choice!

In the next, first an overview of the robotics programme is given, and then the options / possibilities for stepping over from MSc Systems & Control to each MSc Robotics specialisation are presented.

MSc Robotics programme

The MSc Robotics programme is a two-year MSc programme of 120EC. The first year is covered by six compulsory courses that are part of one of the three specialisations of the programme (*Mechatronics and Physical AI*, *Algorithms and Software AI*, and *Human-Robot Interaction and Social AI*). Furthermore, there are three profiles (*Research*, *Design*, and *Innovation and entrepreneurship*) in which 10 EC of courses needs to be selected from predefined lists. To prepare for the MSc-thesis project, the research group of interest can require max. 2 courses (10EC) that must also be attended (*MSc-thesis project preparation* courses).

The second year has 3 variants, as next to the MSc-thesis project either (1) an internship, (2) two more electives and an academic-skills project, or (3) four more electives are scheduled.

Variant 1 of the second year of the MSc Robotics programme consists of an internship of 20 EC and an MSc-thesis project of 40 EC. Students can use the internship as an opportunity to gain international experience. For BSc graduates from universities of applied sciences, variant 2 is set up to boost their academic-skills level to reach the required MSc-Robotics level through an academic-skills project of 10 EC. These students already have performed external projects in their BSc programme and thus may not take the internship. Variant 3, four elective courses and an MSc-thesis project, has been set up to accommodate further deepening in the chosen profile or specialisation (especially the profile Research), or to accommodate performing the MSc-thesis project outside the UT.

To be able to switch from the Systems & Control programme to the MSc Robotics programme, students should at least have attended the courses that are part of the chosen specialisation and profile. This can be courses that are the same in both programmes but can also be courses that match the content of the MSc Robotics courses.

In the tables below for each specialisation within the MSc Robotics, the courses that are overlapping or matching in content are given. The courses listed in the middle column can be attended while in the transition phase. These tables show that the best match is available for the specialisation Mechatronics and Physical AI with 5 overlapping courses. For the other specialisations the overlap is minimal and therefore combining both programmes is rather challenging and requires a fully packed curriculum without too many free choices for the students.

Notes

- Some MSc Robotics courses are still being developed. For this, existing courses that have a large overlap with the new courses can be selected instead. These replacement courses are marked with *^.
- Courses having different names in the left two columns denote courses that evolve from an existing course to a course specific for MSc Robotics, and to express this, the name is changed.
- Courses not in the S&C elective course list need specific approval by the Systems & Control Exam Committee in case you want to stay in the MSc Systems & Control programme and keep such a course on your course list.
- The internship must be done in case you want to stay in the MSc Systems & Control programme. This might be unhandy if you go for variant 3 of the second year. Variant-2 student may not take the internship in both programmes.

Specialisation Mechatronics & Physical AI

While transiting from S&C to Robotics – Mechatronics & Physical AI (see the table below):

- 5 compulsory S&C courses (20 EC) can directly be used
- 1 compulsory S&C course (5 EC) can get a place in the Profile or MSc-thesis project courses
- 1 compulsory S&C course (5 EC) is left over, and can be used as free elective
- 5 specific elective courses (25 EC) must be chosen to cover the rest of the MSc Robotics compulsory courses (all of these are in the S&C course list of elective courses).
- 2 courses must be chosen (10 EC) to cover the selected profile
- Up to 2 courses (max. 10 EC) must be chosen as MSc-thesis project preparation courses

Table 1: Transition table specialisation Mechatronics and Physical AI. Left column: courses needed for MSc Robotics; right column: courses needed for MSc Systems and Control; middle column: replacement courses in the transition phase

Compulsory courses MSc Robotics – Mech. & PAI *Teaching starts Sep 2022*	**Q '22/'23**	**MSc Robotics course content covered by existing courses**	**Q '21/'22**	**Compulsory courses MSc Systems & Control**
Modelling, Dynamics & Kinematics	1A	Modelling & Simulation*	2B +2A?	Modelling & Simulation*
		Modern Robotics	2A	
Design Principles for Robotic and Mechatronic Mechanisms	2A	Design principles for precision mechanisms	2A	
Control System Design for Robotics	1B	Control System Design for Mechatronics	1A	Control System Design for Mechatronics
System Identification with Parameter Estimation and Machine Learning	2B	System Identification and Parameter Estimation	2A	System Identification and Parameter Estimation
		Machine Learning in Engineering OR Machine Learning I	2A	
Software Development for Robotics	2A	Programming 2 OR** Real-time Software Development	2A 1B	

Systems Engineering	1A	Systems Engineering	1A	
ELSE (component)	all	Philosophy of Engineering: Ethics + Perspectives on Engineering Design	1B	Philosophy of Engineering: Ethics + Perspectives on Engineering Design
CBL component	all	Integration project	all	Integration Project
Profile courses (10 EC)		Select from Table 4, 5, 6		Control Course***
MSc-thesis preparation courses (max. 10 EC)		See below		

Notes

* Pre-knowledge is Engineering Systems Dynamics (1B but also in 2A)

** Choose one that fits best to your pre-knowledge

*** Some control courses are suitable for Research Profile, some as MSc-Thesis-Project prep course

Specialisation Algorithms & Software AI

While transiting from S&C to Robotics – Algorithms and Software AI

- 2 compulsory courses (5 EC) can directly be used
- 1 compulsory course (5 EC) can get a place in the Profile or MSc-thesis project courses
- 4 compulsory course (20 EC) are left over and might get a place as Profile and MSc-thesis project courses. Otherwise, these are free electives or extra courses.
- 6 specific elective courses (30 EC) must be chosen.
- Some of these are not in the S&C list of elective courses.
- 2 courses must be chosen (10 EC) to cover the selected profile
- Up to 2 courses (max. 10 EC) must be chosen as MSc-thesis project preparation courses

Table 2: Transition table specialisation Algorithms and Software AI. Left column: courses needed for MSc Robotics; right column: courses needed for MSc Systems and Control; middle column: replacement courses in the transition phase

Compulsory courses MSc Robotics – Alg. & SAI *Teaching starts Sep 2022*	**Q '22/'23**	**MSc Robotics course content covered by existing courses**	**Q '21/'22**	**Compulsory courses MSc Systems & Control**
			2B +2A?	Modelling & Simulation*
			1A	Control System Design for Mechatronics
			2A	System Identification and Parameter Estimation
Robot Perception, Cognition, and Navigation	1B	Positioning and Imaging Technology*^	1A	
Image Processing and Computer Vision	1A	Image Processing and Computer Vision	2A	
Optimal Estimation for Dynamic Systems	2A	Optimal Estimation in Dynamic Systems	1B	
Advanced Software Development for Robotics	2A	Real-time Software Development	1B	

AI for Autonomous Robots: deep learning and reinforcement learning	2B	2D and 3D scene analysis	2A	
Systems Engineering	1A	Systems Engineering	1A	
ELSE (component)	all	Philosophy of Engineering: Ethics + Perspectives on Engineering Design	1B	Philosophy of Engineering: Ethics + Perspectives on Engineering Design
CBL component	all	Integration project	all	Integration Project
Profile courses (10 EC)		Select from Table 4, 5, 6		Control Course***
MSc-thesis preparation courses (max. 10 EC)		See below		

Notes

* Pre-knowledge is Engineering Systems Dynamics (1B but also in 2A)

*** Some control courses are suitable for Research Profile, some as MSc-Thesis-Project prep course

*^ Replacement course not covering all needed content, and only allowed for the transition period

Specialisation Human-Robot Interaction & Social AI

While transiting from S&C to Robotics – Algorithms and Software AI

- 2 compulsory courses (5 EC) can directly be used
- 1 compulsory course (5 EC) can get a place in the Profile or MSc-thesis project courses
- 4 compulsory course (20 EC) are left over and might get a place as Profile and MSc-thesis project courses. Otherwise, these are free electives or extra courses.
- 6 specific elective courses (30 EC) must be chosen
- Some of these are not in the S&C list of elective courses.
- 2 courses must be chosen (10 EC) to cover the selected profile
- Up to 2 courses (max. 10 EC) must be chosen as MSc-thesis project preparation courses

Table 3: Transition table specialisation Human-Robot Interaction and Social AI. Left column: courses needed for MSc Robotics; right column: courses needed for MSc Systems and Control; middle column: replacement courses in transition phase

Compulsory courses MSc Robotics – HRI. & SAI *Teaching starts in Sep 2022*	**Q '22/'23**	**MSc Robotics course content covered by existing courses**	**Q '21/'22**	**Compulsory courses MSc Systems & Control**
			2B +2A?	Modelling & Simulation*
			1A	Control System Design for Mechatronics
			2A	System Identification and Parameter Estimation
Tele-presence in Robotics	2A	Tele-interaction in Robotics *^ + tbd^^	2B	
Human-Robot Communication	1A	Social Robot Design^^	2B	

		Conversational agents^^	2A	
		Natural language processing^^	1A	
Human-Robot Collaboration	2B	tbd^^		
Robot Perception, Cognition, and Navigation	1B	Positioning and Imaging Technology*^	1A	
Systems Engineering	1A	Systems Engineering	1A	
Advanced Software Development for Robotics	2A	Real-time Software Development	1B	
ELSE (component)	all	Philosophy of Engineering: Ethics + Perspectives on Engineering Design	1B	Philosophy of Engineering: Ethics + Perspectives on Engineering Design
CBL component	all	Integration project	all	Integration Project
Profile courses (10 EC)		Select from Table 4, 5, 6		Control Course***
MSc-thesis preparation courses (max. 10 EC)		See below		

Notes

* Pre-knowledge is Engineering Systems Dynamics (1B but also in 2A)

*^ Replacement course not covering all needed content, and only allowed for the transition period

^^ What course serves as a temporary replacement is not yet defined. It becomes clear before the beginning of September 2022.

*** Some control courses are suitable for Research Profile, some as MSc-Thesis-Project prep course

Profile Research

For the Research profile, you must choose 2 courses from the column tagged with your specialisation in the table below. So, the list to choose from is different per specialisation. Most courses are also in S&C list of elective courses.

Table 4 Courses for Profile Research. For each specialisation a different list is presented

Mechatronics and Physical AI	**Algorithms and Software AI**	**Human-Robot Interaction and Social AI**
Learning and Adaptive Control	Machine Learning II	Human Movement Control
Optimal Control	Aerodynamics and Flight Dynamics	Social Robot Design
Robust Control	Embedded Systems Laboratory	Multi-sensory design
Nonlinear Control	Pervasive computing	Advanced project in natural language processing
Nonlinear Dynamics	Deep Learning - From Theory to Practice	Advanced project in brain computer interfaces
Airborne Laser Scanning	Foundations of information retrieval	Deep Learning - From Theory to Practice
Biomechatronics	Data science	Machine Learning II
Time Series Analysis	Biostatistics	Empirical methods for designers
Deep Learning - From Theory to Practice	Airborne Laser Scanning	Concepts, measures and methods

Machine Learning II	Machine learning in Engineering	Foundations of interaction technology
Flexible Multibody Dynamics	Reinforcement learning in Engineering	Biostatistics
Advanced Topics in Finite Element Methods	Uncertainty quantification and model reduction	Advanced Research Projects in Human Robot Interaction
Industrial Robotic Systems	Modelling and Simulation	Time Series Analysis
Fundamentals of Numerical Methods	Advanced computer vision & pattern recognition	Trends in Human-Robot Interaction Research
Biostatistics	Optimal Control	
Active Sound and Vibration Control	Robust Control	
Robotics for Medical Applications	Nonlinear Dynamics	
Automated Production Systems	Nonlinear Control	
Machine Learning in Engineering	Learning and Adaptive Control	
Reinforcement learning in Engineering	Time Series Analysis	
Uncertainty quantification and model reduction	Uncertainty qualification and Data-driven modelling	
Modelling and Simulation	Deep learning for 3D Medical Analysis	

Profile Design

For the Design profile, you must choose 2 courses form the table below. Some courses also in S&C list of elective courses.

Table 5 Courses for Profile Design

Modelling of technical design processes
Engineering Project Management
Smart Environments Integration Project
Manufacturing Facility Design
Safety by design for products, equipment, and systems
Human Centred Design
Introduction to Robotics Design (proposed new title: Design of Flexible and Soft Robotics)
Frontiers in Design and Manufacturing
Social Robot Design

Profile Innovation & Entrepreneurship

For the Innovation & Entrepreneurship profile, the course “Innovation Tournament” is compulsory, and for the other course you must choose from the table below. None of these courses are in S&C list of elective courses.

Table 6 Courses for Profile Innovation & Entrepreneurship. The first course in the list is compulsory

Innovation Tournament (compulsory) – Quartile 1B
I&E Basics: Innovation Management for EIT
Basics of Impact, Innovation & Entrepreneurship
Design Thinking for Service and Business Innovation
Modelling of Technical Design Processes
Engineering Project Management

MSc-Thesis Preparation Courses

The research group of interest can require max. 2 courses (10EC) that should also be attended to prepare for an MSc-thesis project in that research group. These courses are In the tables of this document, such that you might already have some selected. Depending on the research (sub)-group of your choice, courses could be in the S&C list of elective courses.

Elective Courses

With a rather free choice of elective courses, you must complete your individual programme. This to have 120 EC including your MSc-thesis project and maybe internship or academic-skills project (depending on the variant of year 2 you are allowed to take). If you want to take courses *not* in the list below, you have to ask approval from the examination board.

Table 7 Additional Elective Courses

Control for UAVs	Electric Vehicle System Design
Technology for Health	Regulating Robotics and Drones (2.5 EC)
Aerodynamics and Flight Dynamics	Soft Robotics
Identification of human physiological systems	Structural Dynamics
Engineering Acoustics	Conversational agents
Measurement systems for mechatronics	Natural language processing
Transducer Science	Speech processing
Biomechanics of Human Movement	Mastering Tinkering
Capita Selecta Robotics	Virtual reality
Capita Selecta RAM	