

Please note: This publication is an English translation of the Examination Regulations for the M.Sc. Robotic Systems Engineering created by RWTH International Academy. Only the German original of these regulations as published in the Official Announcements of RWTH Aachen University ("Amtliche Bekanntmachungen") is legally binding.

Program-Specific Examination Regulations

for the Master's degree program

Robotic Systems Engineering

of RWTH Aachen University

dated

(2021 version of the Examination Regulations)

On the basis of §§ 2 para. 4, 64 of the law governing the universities of the Federal State of North Rhine-Westphalia (Higher Education Act – HEA) in the version of the announcement dated September 16, 2014 (GV. NRW p. 547), most recently amended by Article 1 of the Act on further protective measures taken in management of the Corona pandemic within the context of higher education dated December 1, 2020 (GV. NRW p. 1110), RWTH Aachen University (RWTH) has issued the following examination regulations:

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I. General Information

§ 1

Scope of Application and Academic Degree

- (1) These Examination Regulations apply to the Master's degree program Robotic Systems Engineering at RWTH Aachen University. They apply in conjunction with the General Examination Regulations (GER) in their relevant applicable version only, and include additional program-specific regulations. In cases of doubt, the General Examination Regulations take precedence over the program-specific Examination Regulations.
- (2) After the successful completion of this Master's degree program, the Faculty of Mechanical Engineering awards the academic degree of Master of Science RWTH Aachen University (M. Sc. RWTH).

§ 2

Type and Objectives of the Study Program and Language Provisions

- (1) This is a Master's degree program for the purpose of further education according to § 2 para. 4 GER.
- (2) The overall educational objectives are set out in § 2 para. 1, 3 and 4 GER. For further information and provisions on the objectives of this Master's degree program, please refer to appendix 2 of the present Examination Regulations.
- (3) Teaching takes place in the English language.

§ 3

Admission Requirements

- (1) Requirement for admission is a recognized first degree from a recognized university according to § 3 para. 4 GER.
- (2) To meet the educational prerequisites, the applicant must prove the competences required to successfully complete the Master's degree program Master of Science Robotic Systems Engineering.

The applicant must prove that they acquired the required Credit Points in the listed fundamental modules of the Bachelor's degree program Mechanical Engineering at RWTH Aachen university to a comparable extend in the following areas (Fundamentals in Engineering Sciences, Fundamentals in Mathematics and Natural Sciences and Fundamentals in System Sciences):

- A total of 85 Credit Points from the fields of engineering, mathematics and natural sciences. The proven performance must be comparable to the Bachelor's degree program Mechanical Engineering at RWTH Aachen.
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- A total of 16 Credit Points from the fundamentals in system sciences. The proven performance must be comparable to the Bachelor's degree program Mechanical Engineering at RWTH Aachen.

Fundamentals of Engineering Sciences: <ul style="list-style-type: none"> - Mechanics I - Mechanics II - Mechanics III - Machine Design - Machine Design II - Machine Design III - Basics of Electrical Engineering for Mechatronic Systems - Materials Science I/II - Thermodynamics I/II - Engineering Design I - Manufacturing Technology I - Introduction to CAD 	60 CP
Fundamentals of Mathematics and Natural Sciences: <ul style="list-style-type: none"> - Physics - Mathematics I - Mathematics II - Mathematics III - Numerical Mathematics 	25 CP
Fundamentals of System Sciences: <ul style="list-style-type: none"> - Computer Science in Mechanical Engineering - Simulation Methods in Mechanical Engineering - Control Engineering 	16 CP

In addition, all applicants are required to successfully pass the Graduate Record Examination (GRE) General Test. Applications without the GRE will not be considered. The following minimum scores must be achieved in the individual sections:

Verbal Reasoning: 145 points
 Quantitative Reasoning: 160 points
 Analytical Writing: 3 points

Applicants who are citizens of a member state of the European Union or the European Economic Area (EEA), as well as graduates with a Bachelor's degree from a German university are exempt from this rule.

- (3) When admission is granted on condition of completion of additional requirements, § 3 para. 6 GER applies. If additional requirements corresponding to more than 30 Credit Points are required, admission to this Master's degree program is not possible.
- (4) For this Master's degree program, proof of adequate proficiency in the English language must be provided according to § 3 para. 9 GER.
- (5) § 3 para. 12 GER applies for determining whether admission requirements are met.
- (6) General regulations on the recognition of prior examination performances are set out in § 13 GER.

§ 4
**Standard Period of Study, Curriculum,
 Credit Points and Scope of Study**

- (1) The standard period of study is four semesters (two years) full-time, including preparation of the Master's thesis. This study program can only be commenced in the winter semester.
- (2) This study program consists of compulsory modules and compulsory elective modules comprising 120 Credit Points. The scope of the Master's thesis is 30 Credit Points. A total of 120 Credit Points must be acquired to successfully complete this program. The Master's examination is composed as follows:

Compulsory courses in Engineering at RWTH	47 CP
Compulsory elective courses in Engineering at RWTH	33 CP
Internship or Research Project	10 CP
Master's Thesis	30 CP
Sum	120 CP

- (3) Depending on the composition of the compulsory electives, this program comprises 18 to 20 modules, including the Master's thesis module. All modules are defined in the module handbook. The weighting of the examinations with Credit Points to be taken in the individual modules is carried out in compliance with § 4 para. 4 GER.
- (4) In administering this program, RWTH International Academy gGmbH ensures that the standard period of study can be adhered to, and that the modules required for a degree in particular and the corresponding examinations as well as the master's thesis can be completed within the scheduled time frame and deadlines.

§ 5
Obligatory Attendance in Classes

- (1) According to § 5 para. 2 GER, obligatory attendance can only be stipulated in courses of the following type:
 1. Tutorials
 2. Seminars
 3. Colloquia
 4. (Laboratory) practicals
- (2) Courses, for which attendance is compulsory according to para. 1, are identified as such in the module catalog.

§ 6
Examinations and Examination Deadlines

- (1) General regulations on examinations and examination deadlines are stipulated in § 6 GER.

- (2) If the successful participation in modules or examinations or passing of module components according to § 5 para. 4 GER is stipulated as a precondition for participation in other examinations, this is indicated accordingly in the module catalog.

§ 7 Types of Examinations

- (1) General regulations on types of examination are stipulated in § 7 GER.
- (2) The following other forms of examination are stipulated by § 7 para. 1 GER:
1. In **simulation games**, students learn to implement the given company projects in teams (small groups) while assuming a defined assigned role. Simulation games can be computer-aided on the basis of programmed software or without such software. Students make active (managerial) decisions on the basis of defined rules and content discussed in the other modules, which are to be implemented in actions. Simulation games can be offered in cooperation with one or more university lecturers, or together with management practice. The latter may evaluate the results as a jury.
 2. Special didactical modules are project modules and can involve e.g. a **case study work and case study discussions**, a **video interview** or a **video description** as examination. In project modules with special didactical formats, students learn to work together in teams and to successfully implement content covered in other modules. The focus of project modules with special didactical formats can either be on theory or on application. Topics and content of project modules may be defined on a semester-specific basis.
 3. For a **case study report**, the following applies specifically: in a project (Case Study), students will in a small group under tutelage independently work out the solution to a narrowly defined and practical problem and describe it in writing. The scope of the written description is at least 5 and at most 100 pages.
 4. During their **internship**, students will acquire knowledge of the technical processes used in practice as well as the economic processes used to select and control them and gain insights into the social processes and structures of companies. The internship is evaluated on the basis of the internship report. Further information can be found in appendix 3.
- (3) The duration of a written examination is ...
- 60 to 120 minutes for up to 5 Credit Points awarded
 - 120 to 180 minutes for 6 to 9 Credit Points awarded
 - 180 to 240 minutes for 10 to 15 Credit Points awarded.
- (4) The duration of an oral examination is 15 minutes at least and 60 minutes at most per candidate. An oral examination as a group examination is carried out with no more than four candidates.
- (5) The scope of a written paper is 10 to 20 pages. The time frame for completing a written paper is at least 75 and at most 150 hours.
- (6) The following applies to project work in particular: in the Research Project, students will under scientific tutelage work on a scientific problem from the field of Mechanical Engineering.
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- 1) For their Research Project, students will usually work alone, or in groups of two to five, depending on the research topic
 - 2) The scope of a Research project is at most 30 pages. The working time is 300 hours.
 - 3) In justified individual cases, the Examination Board may extend the duration of the working time by up to two weeks upon justified application from the candidate and approval from the supervisor.
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- (7) The scope of a written preparation for a presentation is 5 to 10 pages. The duration of a presentation is 15 to 45 minutes.
 - (8) The following applies to colloquia in particular: the duration of a colloquium is 30 minutes at least and 60 minutes at most.
 - (9) At the start of a course, the examiner specifies the duration of the examination and, if applicable, other modalities of the examination.
 - (10) Admission to module examinations may be conditional on the successful completion of module components as pre-examination within the meaning of § 7 para. 15 GER. For relevant modules, this will be outlined in the module catalog. At the start of the semester and no later than by the time of the first course session, the lecturer provides precise criteria in the CMS regarding possible improvement of grades through the completion of module components, particularly the amount and type of tutorials qualifying for bonus as well as the mode of correction and evaluation.

§ 8 Assessment and Grading

- (1) General regulations on assessing examinations and on the formation of grades are stipulated in § 10 GER.
- (2) If an examination consists of several tests, each test must be passed, or have a grade of at least "sufficient" (4.0).
- (3) A module has been passed, if all associated partial examinations have been passed with a grade of at least "sufficient" (4.0), and all other Credit Points have been achieved or module components have been completed.
- (4) The overall grade is formed taking into account all module grades and the grade of the Master's thesis according to § 10 para. 10 GER.
- (5) In accordance with § 10 para. 13 GER, one weighted module grade corresponding to a maximum of 5 Credit Points can be removed from the student's academic record, in the case that all module examinations of the Master's degree program have been completed within the standard period of study.

§ 9 Examination Board

The responsible Examination Board according to § 11 GER is the Master's Examination Board Mechanical Engineering of the Faculty of Mechanical Engineering.

§ 10
**Repeating Examinations or the Master's Thesis and the
Loss of Right to Examination**

- (1) General provisions on repeat examinations, the Master's thesis, and the loss of right to examination are stipulated in § 14 GER.
- (2) Freely selectable modules within an area of this Master's degree program (compulsory elective area) can be replaced, provided the examination of the relevant module was not evaluated as "failed", and provided this is permitted in the relevant module catalog. It is not possible to change compulsory modules.

§ 11
**Deregistration, Non-Attendance, Withdrawal,
Deception, Non-Compliance**

- (1) General provisions on deregistration, non-attendance, withdrawal, deception or noncompliance are stipulated in § 15 GER.
- (2) The following applies to deregistration from practical work and seminars: deregistration from block courses is possible up to one day before the first course session.
- (3) With special didactical modules, a candidate may deregister from an examination up to two weeks before the first relevant day of examination without stating reasons.

II. Master's Examination and Master's Thesis

§ 12
Type and Scope of the Master's Examination

- (1) The Master's examination consists of
 1. examinations that are to be completed based on the structure of the degree program according to § 4 para. 2 and detailed in the module catalog, as well as
 2. The Master's thesis and the Master's colloquium.
 - (2) The order of courses is based on the curriculum (appendix 1). The assignment of the Master's thesis can only be issued if 80 Credit Points have been attained.
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§13 Master's Thesis

- (1) General regulations on the Master's thesis are set out in § 17 GER.
- (2) Regarding the supervision of the Master's thesis, reference is made to § 17 para. 2 GER.
- (3) The Master's thesis is written in the English language.
- (4) The time frame for students to complete their Master's thesis usually is 18 weeks at least and 22 weeks at most alongside studies. In justified exceptional cases, the time frame can be extended by a maximum of up to six weeks upon application to the Examination Board in accordance with § 17 para. 7 GER. The scope of the written work should not exceed 80 pages without annexes.
- (5) The workload for preparing and composing the Master's thesis and for the colloquium corresponds to 30 Credit Points.

§ 14 Acceptance and Assessment of the Master's Thesis

- (1) General provisions on acceptance and assessment of the Master's thesis are stipulated in § 18 GER.
- (2) The Master's thesis must be submitted in due time in duplicate copies to the Central Examination Office (Zentrales Prüfungsamt, ZPA). The copies must be printed and bound. Additionally, the thesis must be submitted as a PDF file on a data storage device.

III. Final Provisions

§ 15 Viewing of Examination Files

Review of examination documents is carried out in accordance with § 22 GER.

§ 16 Coming into Effect, Publication and Transitional Provisions

- (1) These Examination Regulations will come into effect in the Winter Semester 2021/2022 and are published in the Official Announcements of RWTH Aachen University ("Amtliche Bekanntmachungen").
 - (2) These Examination Regulations apply to all students who enrolled in the Master's degree program Master of Science Robotic Systems Engineering at RWTH Aachen University for the first time in or after the Winter Semester 2021/2022.
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- (3) Students who enrolled in the Master's degree program Master of Science Robotic Systems Engineering before the Winter Semester 2021/2022 may apply to transfer to the present Examination Regulations. The Examination Regulations dated May 17, 2019 will apply to students until the end of the Summer Semester 2024 at maximum. After the Summer Semester 2024, it is mandatory to transfer to the present Examination Regulations.
- (4) Examinations completed based on the Examination Regulations dated May 17, 2019 in their currently valid version are transferred to the examinations required by the present Examination Regulations with the help of the equivalence list in appendix 4.

Issued based on the resolutions of the Faculty Council of the Faculty of Mechanical Engineering dated December 15, 2020 and February 23, 2021.

It should be noted that, according to § 12, para. 5 of the law governing the universities of the Federal State of North Rhine-Westphalia (Higher Education Act - HEA), a violation of procedural or formal regulations of the regulatory law or other autonomous law of the university can no longer be asserted after the expiry of one year from the date of this announcement, unless

- 1) the regulations were not duly announced,
- 2) the rector's office has previously objected to the decision of the body deciding the regulations,
- 3) the university has been notified in advance of the formal or procedural defect, indicating the legal provision that has been violated and the fact that gives rise to the defect, or
- 4) the legal consequences of the exclusion of the right of appeals was not pointed out when the regulations were published.

The Rector
of RWTH Aachen University

Aachen, July 27, 2021

sgd. Rüdiger

Univ.-Prof. Dr. rer. nat. Dr. h. c. mult. U. Rüdiger

Appendix 1: Curriculum

M.Sc. in Robotic Systems Engineering

	Module	CP	WS - 1. Sem.			SS - 2. Sem.			WS - 3. Sem.			SS - 4. Sem.		
			L	E	P	L	E	P	L	E	P	L	E	P
			SWS			SWS			SWS			SWS		
RWTH Aachen	Compulsory Courses	26												
	Robotic Systems	5	2	2										
	Advanced Robotic Kinematics and Dynamics	5	2	2										
	Control Engineering	3	2	2										
	Machine Learning	6	3	1										
	Computer Science in Mechanical Engineering II	5	2	2										
	Language Course	2	1	1										
	Compulsory Courses	11												
	Multibody Dynamics	5				2	2							
	Computer Vision I	6				3	1							
	Compulsory Course	10												
	Robotic Sensor Systems	5							2	2				
	Simulation of Robotic Systems, Sensors and Environment	5							2	1				
	Elective Courses	33		4-6			17-19			10				
	Internship (Industrial Track) or Research Project (Academic Track)	10								10				
	Master Thesis	30												30
	Master Defense Colloquium													
	Total	120		30-32			28-30			30				30

Elective Courses	CP	L	E	P	Term
Production Metrology	5	2	2		SS
Machine Dynamics of Rigid Systems	6	2	2		SS
Industrial Logistics	5	2	1		SS
Artificial Intelligence and Data Analytics for Engineers	5	2	2		SS
International Factory Planning	6	2	2		SS
Advanced Electrical Drives	4	2	1		SS
Summer School** - Advanced Topics in Robotic Systems Engineering	3	2	2		SS
Advanced Machine Learning	6	3	1		SS
Introduction to Artificial Intelligence	6	2	2		WS
Power Electronics	5	3	1		WS
Processes and Principles for Lightweight Design	6	2	2		WS
Applied Numerical Optimization Engineering	4	2	2		WS
Numerical Methods in Mechanical Engineering	7	3	2		WS
Advanced Finite Element Methods for Engineers	5	2	2		WS
Strategic Technology Management	5	2	2		WS
Mechatronics and Control Techniques for Production Plants	6	2	2		WS
Advanced Control Systems	4	2	1		WS

Module
Compulsories
Electives
Internship Industry / Research Project
Master Thesis
Total

WS = Winter Semester
 SS = Summer Semester
 L = Lecture
 E = Exercise
 CP = Credit Points

** Digital Work: Challenges and Solutions (Prof. Lang, Dr. Mertens) & more

Appendix 2: Objectives of the Master's degree program

This Master's degree program was designed as a postgraduate continuation of fundamental Bachelor degree programs in engineering, and aims at an in-depth, vocationally qualifying specialization in the fields of Robotic Technology, Robotics and Automation.

Graduates receive a modern and certified education to take on future tasks in the specialization areas in

- development of optimized solutions for the use of robots
- development and construction of new robotic solutions

aiming at advancing robotics related industry. They thus acquire advanced knowledge in the field of Robotic Technology as well as in-depth knowledge of the related application of computer-aided design software used for the conception and realization of complex technical solutions for robotic applications and automation techniques.

Aspiring graduates will experience robots as typical examples of mechatronic systems, which develops into an optimal solution through the useful combination of mechanics, engines, sensors and information processing.

In addition to conception and development, the organization of workflows and the monitoring of manufacturing processes also form a part of the tasks of the future robotics engineer.

This program enables graduates to work scientifically and conveys in-depth, theoretical and analytical knowledge regarding expertise and methods in engineering sciences.

Graduates are competent in communicating and appreciating the highly complex technical applications of robotic technology as interdisciplinary in the context of increasing mechanization, and to place them in an appropriate context while aiming for solution-oriented, sustainable developments. Furthermore, graduates have access to the latest research will can be independently applied to their studies. They can use their knowledge creatively to gain new insights and solve problems, and demonstrate a critical awareness of the complexity of the intersectional tasks of engineering science and social issues (increasing digitalization of professional and personal environment). They have the knowledge and skills to recognize new developments and technologies at an early stage as well as to evaluate their significance within a specific area or project.

Appendix 3: Internship guidelines

1. Purpose of the internship

Practical work experience (or internship) in companies is essential for students to evaluate their choice of program, to understanding technical modules sufficiently and to prepare for their future career (in Germany). Students will acquire knowledge of technical processes used in practice as well as the economic processes used to select and control them. They will also gain insights into the social processes and structures of companies.

2. Duration and structure of the internship

In the Master of Science in Robotic Systems Engineering students need to complete at least 12 weeks of practical work experience.

3. Internship companies

- (1) Students are wholly responsible for organizing suitable internship positions.
- (2) The internship will be regulated legally by the internship contract between the company and the student. The contract stipulates all rights and obligations of the student and the company.
- (3) Interns usually receive payment from the company, however this may vary between companies.
- (4) Missed working days (vacation, sickness, and other absences) – except for public holidays – must be made up in any event.
- (5) Interns are subject to compulsory insurance. Information on compulsory insurance can be obtained from German health insurance providers.
- (6) As a general rule, internships at university institutes (including affiliated institutes) and at a student's own or their parents' company cannot be recognized.

4. Recognition of the internship

- (1) The program's Academic Director is in charge of recognizing a student's internship and issuing the final certificate.
 - (2) In order that the internship is recognized, students must submit the original of the internship report compiled in accordance with point 5 of these guidelines as well as the original of the internship certificate issued in accordance with point 6 of these guidelines.
 - (3) Late submission of the documents referred to in (2) may lead to non-recognition of the internship due to lack of verifiability. The relevant deadlines are specified in (6).
 - (4) Overall recognition will only be granted, if the internship of the required length has been completed and the internship report and certificate have been submitted within the given deadlines.
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- (5) Appeals against recognition decisions may be lodged with the Examination Board for Mechanical Engineering within one month after notification of the decision. The Examination Board will decide on the appeal. The Examination Board will communicate its decision in writing.
- (6) The following deadlines must be observed in the recognition process: The complete internship documents (internship report and internship certificate) must be submitted to the Internship Office (Praktikantenamt) of the Faculty of Mechanical Engineering no later than two months after the end of the internship.

5. Internship report

- (1) During their internship, interns are required to write a report on their work and activities.
- (2) Students must use record books or stapled DIN A4-pages. The scope of the internship report must be 2 DIN A4-pages per week (drawings and texts).
- (3) The content of the internship report must be elaborated as a coherent text, preferably undergone sufficient computer editing. In the coherent text, the student will briefly describe their tasks during the internship. In addition, the student should spend at least one page on critically reflecting on the internship (e.g. supervision, learning objectives and successes or problems). Worksheets and copies (e.g. regulations, literature, etc.) will not replace the student's report. Reports must be stamped and signed by the instructor.

6. Internship certificate

- (1) At the end of their work experience, the student receives a certificate from the internship company, stating the duration of the internship in the respective departments or the student's tasks and the number of days of absence due to illness or leave.
- (2) The certificate must be issued by the company at which the internship was carried out. Certificates from recruitment agencies may not be recognized.

7. Internships abroad

- (1) Students are recommended to complete their internship abroad. The above guidelines apply to the recognition of such internships.
 - (2) Regarding the recognition of internships abroad, students need to consult their program manager and their academic director.
 - (3) These guidelines are valid for all applicants living abroad and wishing to study at RWTH Aachen University without exception.
 - (4) The internship report and the internship certificate must be written and issued in German or English. The internship certificate may also be a certified translation into German or English, provided that the original document in the corresponding national language is submitted as well.
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Appendix 4: Equivalence list

M.Sc. Robotic Systems Engineering Äquivalenzliste Übergang PO 2019/077 zu PO 2021			
Module Prüfungsordnung 2019	CP	Module Prüfungsordnung 2021	CP
Robotic Systems (P)	5	Robotic Systems (P)	5
Advanced Robotic Kinematics and Dynamics (P)	5	Advanced Robotic Kinematics and Dynamics (P)	5
Control Engineering (P)	3	Control Engineering (P)	3
Machine Learning (P)	6	Machine Learning (P)	6
Computer Science in Mechanical Engineering II (P)	5	Computer Science in Mechanical Engineering II (P)	5
German Language Course (P)	2	Language Course (P)	2
Multibody Dynamics (P)	5	Multibody Dynamics (P)	5
Computer Vision I (P)	6	Computer Vision I (P)	6
Robotic Sensor Systems (P)	5	Robotic Sensor Systems (P)	5
Simulation of Robotic Systems, Sensors and Environment (P)	5	Simulation of Robotic Systems, Sensors and Environment (P)	5
Internship (WP)	10	Internship (WP)	10
Research Project (WP)	10	Research Project (WP)	10
Production Metrology (WP)	5	Production Metrology (WP)	5
Machine Dynamics of Rigid Systems (WP)	6	Machine Dynamics of Rigid Systems (WP)	6
Industrial Logistics (WP)	5	Industrial Logistics (WP)	5
Artificial Intelligence and Data Analytics for Engineers (WP)	5	Artificial Intelligence and Data Analytics for Engineers (WP)	5
Factory Planning (WP)	6	International Factory Planning (WP)	6
International Factory Planning (WP)	6	International Factory Planning (WP)	6
Advanced Electrical Drives (WP)	4	Advanced Electrical Drives (WP)	4
Summer School- Advanced Topics in Robotic Systems Engineering (WP)	3	Summer School - Advanced Topics in Robotic Systems Engineering (WP)	3
Advanced Machine Learning (WP)	6	Advanced Machine Learning (WP)	6
Computer Vision II (WP)	6		
Introduction to Artificial Intelligence (WP)	6	Introduction to Artificial Intelligence (WP)	6
Power Electronics (WP)	5	Power Electronics (WP)	5
Processes and Principles for Lightweight Design (WP)	6	Processes and Principles for Lightweight Design (WP)	6
Applied Numerical Optimization Engineering (WP)	4	Applied Numerical Optimization Engineering (WP)	4
Numerical Methods in Mechanical Engineering (WP)	7	Numerical Methods in Mechanical Engineering (WP)	7
Advanced Finite Element Methods for Engineers	5	Advanced Finite Element Methods for Engineers	5
Strategic Technology Management (WP)	5	Strategic Technology Management (WP)	5
Mechatronics and Control Techniques for Production Plants (WP)	6	Mechatronics and Control Techniques for Production Plants (WP)	6
Advanced Control Systems (WP)	4	Advanced Control Systems (WP)	4