Curriculum for the Master's Degree Programme

Production Science and Management

Curriculum 2020

This curriculum was approved by the Senate of TU Graz at the meeting of May 25, 2020.

The legal bases of this degree programme are the Universities Act (UG) and the section of the TU Graz statute on 'Legal Regulations for Academic Affairs', as amended.

(Please note: The English version of this document is a courtesy translation. Only the German version is legally binding.)

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I General

§ 1 Subject Matter of the Degree Programme and Qualification Profile

The engineering master's degree Production Science and Management is a four-semester programme. The total programme corresponds to 120 ECTS credits in accordance with § 54 (3) UG.

The master's degree programme Production Science and Management is provided as a foreign-language study programme (in English) in the sense of § 63a (8) UG.

Graduates of this study programme are awarded the academic degree 'Diplom-Ingenieurin' or 'Diplom-Ingenieur', abbreviated as 'Dipl.-Ing.' or 'DI'. Internationally, this academic degree corresponds to the 'Master of Science', abbreviated as 'MSc'.

(1) Subject matter of the degree programme

Production Science and Management covers relevant topics of both engineering and business – ranging from components to digitalization, from corporate management to design of business models, in a holistic management system with a strong focus on production. As a degree programme it combines a solid and broad basic education with state of the art content in the fields of 'Advanced Technologies' and 'Management and Operations'. Building on the foundations of a scientifically oriented bachelor's degree in 'Mechanical Engineering and Business Economics' (Engineering Economics) or an equivalent bachelor's degree, the programme strengthens and deepens the relevant foundations of engineering and business science in general and especially in production science.

Due to the increasingly important international and global orientation of our programme and graduates all courses are taught exclusively in English.

(2) Qualification profile and competences

The English-language master's degree programme *Production Science and Management* at TU Graz is designed to give students an advanced education in production science that builds on the competences acquired in the general engineering and economics subject fields.
The graduates have successfully and substantially expanded their knowledge in one engineering subject and one business subject. These two advanced subject groups are:

- Advanced Technologies
- Management and Operations

The master's degree will be awarded to students who have successfully demonstrated the following knowledge, skill and competences:

Knowledge and Understanding
The graduates

- have developed an in-depth understanding of the relevant fundamentals of mechanical engineering, especially in the field of production engineering,
- have developed an in-depth understanding of the relevant fundamentals of management,
- are familiar with the major theories, principles and methods of production engineering and have deepened their knowledge in this field,
- are familiar with the major theories, principles and methods of management and have deepened their knowledge of management,
- have acquired capabilities of analysis and generalization and of interconnected and systematic thinking, and
- have learned to think and act in accordance with good business practice.

Application of Knowledge
The graduates

- are able to apply theoretical knowledge of engineering and science topics to practical projects in technology-related fields,
- are able to apply their knowledge and problem-solving abilities in new and unfamiliar situations,
- are able to describe and interpret special aspects, boundaries, terminology and schools of thought in their subject area, and
- are able to do scientific work independently and are therefore qualified to proceed to a doctoral programme.

Professional Judgement
The graduates

- are able to deal with complex situations,
- are able to formulate reasoned opinions in the terms of the relevant disciplines, including taking account of incomplete or limited information, and
- are able to take account of societal, social and ethical consequences of their actions as experts in their subject.

Communicative, organizational and social competences
The graduates

- are competent in communication and presentation techniques
- are able to write scientific texts,
- are flexible, adaptable and able to work in teams,
- are able to use learning strategies for autonomous learning and understand the importance of keeping their knowledge and skills up to date, and
- are able to work independently as well as in teams.

(3) Need and relevance of the degree programme for the academic disciplines and for the employment market

There is strong demand on the employment market for the subject Production Science and Management. Graduates have excellent employment prospects thanks to their sound education in engineering and business principles and methods, and their advanced knowledge.

Industry places high demands on engineers of today. The differentiation and specialization of companies is constantly increasing. Degree programmes cannot cover all the specialty areas. This means that it is even more important for graduates to have a deep and wide knowledge of the basic engineering and economic principles of production science. Additionally, the graduates have achieved the transition from fundamental principles to applications, – which they demonstrate especially in the chosen specialization subjects of the degree programme Production Science and Management – and have acquired the methodological knowledge they need for this transition. With this study profile they are optimally equipped for their subsequent careers – even beyond their original specialist subject. In this way graduates have outstanding prospects on the employment market.

II General Regulations

§ 2 Admission Requirements:

(1) Admission to a master's degree programme requires a bachelor's degree in a relevant subject or a bachelor's degree from a technical college (*Fachhochschule, university of applied sciences*) in a relevant subject or another equivalent degree from a recognized post-secondary educational institution in Austria or abroad (§ 64 (3) UG).

(2) The master's degree in Production Science and Management is primarily designed for graduates of the bachelor's degree in Mechanical Engineering and Business Economics at TU Graz. In addition, admission to the master's degree programme in Production Science and Management is open to graduates of the following degrees, which are deemed relevant without any special conditions:

- Bachelor's degree in Mechanical Engineering (TU Graz)
- Bachelor's degree in Mechanical Engineering – Management (TU Wien)
- Bachelor's degree in Mechanical Engineering (TU Wien)

(3) For degree programmes that are generally equivalent to a relevant degree programme (Fig. 2) but come short of full equivalence in a few specific aspects, full equivalence can be achieved by requiring applicants to complete additional courses and examinations from the bachelor's programme in Mechanical Engineering and Business Economics, up to a maximum amount of 30 ECTS credits. These additional courses can be credited with up to 5 ECTS towards free-choice subjects in the study programme.

(4) In order to accumulate a total of 300 ECTS credits of additional studies, it is not allowed to count the same course both as part of the bachelor's degree required for admission to the master's programme and as part of the master's degree programme.

§ 3 Allocation of ECTS Credits

For all study activities which are successfully completed by the students ECTS credits are awarded. These credit points reflect the workload of each course or assignment relative to the workload of an academic year, which is intended to be 1500 actual hours, corresponding to 60 ECTS credits (i.e. 25 actual hours per 1 ECTS credit). The workload includes individual study time as well as the time in organized course activities. A 'semester hour' is 45 minutes per teaching week of a semester.

§ 4 Structure of the Degree Programme

The master's degree programme Production Science and Management with a total volume of 120 ECTS credits is a four-semester programme and is structured in modules, consisting of:

1. A module on fundamental principles (compulsory module A), for 15 ECTS credits.
2. A module on advanced topics in Advanced Technologies (B), consisting of
    a. Compulsory courses (compulsory modules B1 and B2), for 21 ECTS credits,
    b. Elective subjects (elective module B3), for 10 ECTS credits, chosen from the corresponding elective module,
    c. A laboratory course (elective module B4), for 3 ECTS credits, chosen from the corresponding elective module,
3. A module on advanced topics in Management and Operations, consisting of
    a. Compulsory courses (compulsory modules C1 and C2), for 25 ECTS credits
    b. Elective subjects (elective module C3), for 10 ECTS credits, chosen from the corresponding elective module,
4. Free-choice courses for 6 ECTS credits,
5. Foreign internship/work experience

    The students are strongly recommended to take a subject-related internship for a total of 8 weeks in a non-German speaking foreign country during this master's programme.

6. A master's thesis, for 30 ECTS credits

   The topic of the master's thesis must belong to a compulsory subject or an elective subject of the degree programme as set out in § 8 and § 9 and must be supervised by an institute of the Faculty of Mechanical Engineering and Economic Sciences. Any exceptions must be checked and approved by the Dean of Studies.

Compulsory module A:	**15 ECTS**	Basics (A)
Compulsory module B:	**∑ 34 ECTS**	Advanced Technologies (B) Compulsory: Factory Planning (B1), Automation (B2) 21 ECTS Elective: Advanced Technologies (B3) 10 ECTS Elective: Laboratory Exercise Advanced Technologies (B4) 3 ECTS
Compulsory module C:	**∑ 35 ECTS**	Management and Operations (C) Compulsory: Management (C1), Operations (C2) 25 ECTS Elective: Management and Operations (C3) 10 ECTS
Free-choice courses	**6 ECTS**	Free-choice courses
Master's thesis	**30 ECTS**	Master's thesis
∑	**120 ECTS**	

The following table shows how the total ECTS credits are divided up between compulsory subjects, elective catalogues and free-choice courses.

Duration of master's degree programme PSM		4 semesters
Volume of courses to be completed		
Total workload excluding master's thesis		**90** ECTS credits
Compulsory subject	**61** ECTS credits	
Elective subject (including laboratory course)	**23** ECTS credits	
Free-choice courses	**6** ECTS credits	
Master's thesis		**30** ECTS credits
Total of master's degree programme in Production Science and Management		**120** ECTS credits

§ 5 Course types

The types of courses provided at TU Graz are set out in § 4 of the section of the TU Graz statute on 'Legal Regulations for Academic Affairs' (see Appendix IV).

§ 6 Group sizes

The following maximum numbers of participants (group sizes) are stipulated for the following types of courses:

(1) For exercises (UE) and for the exercise parts of lectures with integrated exercises (VU), the maximum group size is 25.

(2) For laboratory courses (LU) the maximum group size is 6.

(3) For projects (PT) and seminars (SE) the maximum group size is 20.

§ 7 Rules for Allocation of Places in Courses

(1) If the number of students who register for a course exceeds the number of places available on the course, the course has to be provided for extra groups, if necessary also in the recess periods.

(2) If it is not possible to provide enough 'parallel' courses (groups), then students have to be allocated places on the course according to the following priority criteria:

a. The course is compulsory for the student as per the curriculum.

b. The total of the courses already completed in the student's current degree programme (total of ECTS credits)

c. The date on which the student fulfilled the participation criteria for the course (earlier date = higher priority).

d. Students who were not admitted to an earlier instance of the course or who have to repeat the course, should be admitted preferentially to the next instance of the course.

e. The grade of the examination – or the grade average of examinations (weighted by ECTS credits) – in the course(s) required to be completed as admission criteria.

f. Students for whom this type of course is not required in order to complete their curriculum, will only be admitted according to the availability of free places; they can be entered into a separate waiting list. The above rules apply among them also.

(3) Up to 10% of the existing places on the course are reserved for students completing part of their studies at TU Graz as part of a mobility programme.

III Degree Programme Contents and Sequence

§ 8 Modules, Courses and Sequence in the Semesters

The individual courses of this master's degree programme and their designation as compulsory and elective modules are set out below. The knowledge, methods or skills to be taught in each course are described in detail in Appendix 1. The assignment of courses to particular semesters is a recommendation and ensures that the sequence of courses is best able to build on prior knowledge and that the workload of an academic year does not exceed 60 ECTS credits. The fourth semester is reserved for work on the master's thesis.

Unless stated otherwise, courses of type "VU" are divided in 2/3 VO and 1/3 UE.

Master's Degree Programme Production Science and Management								
Module	**Course**				**Semester with ECTS credits**			
		SSt.	**LV Type**	**ECTS**	**I**	**II**	**III**	**IV**
Compulsory Module A: Basics								
[A.1]	Industrial Management Seminar	2	SE	2		2		
[A.2]	Advanced Processing Technologies (IMAT)	3	VO	4	4			
[A.3]	Advanced Processing Technologies (IFT)	1	VO	1.5	1,5			
[A.4]	Engineering and Business Informatics	1	VO	1.5		1.5		
[A.5]	Engineering and Business Informatics	1	UE	1		1		
[A.6]	Production Theory and Analytics	2	VU	2	2			
[A.7]	Plasticity and Forming Processes	2	VO	3		3		
Subtotal Compulsory Module A		**12**		**15**	**7.5**	**7.5**		
Module Group B: Advanced Technologies								
Compulsory Module B1: Factory Planning								
[B.1.1]	Industrial Engineering	2	VO	3	3			
[B.1.2]	Industrial Engineering	1	UE	1	1			
[B.1.3]	Material Flow Planning and System Design	3	VU	3	3			
[B.1.4]	Design for Manufacturing	2	VU	2	2			
Subtotal Compulsory Module B1		**8**		**9**	**9**			
Compulsory Module B2: Automation								
[B.2.1]	Engineering and Automation Technologies in Intralogistics	3	VU	3	3			
[B.2.2]	Process simulation of Manufacturing Technologies	3	VU	3		3		
[B.2.3]	Robotics and Automation	2	VO	3	3			
[B.2.4]	Advanced IT Application in Production Systems	3	VU	3		3		
Subtotal Compulsory Module B2		**11**		**12**	**6**	**6**		
Subtotal B Advanced Technologies		**19**		**21**	**15**	**6**		

Module Group C: Management and Operations								
Compulsory Module C1: Management								
[C.1.1]	Technology Management	2	VO	3	3			
[C.1.2]	Enabling Innovation	1	VO	1.5		1,5		
[C.1.3]	Enabling Innovation	1	UE	1		1		
[C.1.4]	Management Control Systems	3	VO	4.5	4,5			
[C.1.5]	General Management and Organisation	2	VO	3		3		
[C.1.6]	General Management and Organisation (PSM specific cases)	2	UE	2		2		
Subtotal Compulsory Module C1		**11**		**15**	**7,5**	**7,5**		
Compulsory Module C2: Operations								
[C.2.1]	Production Planning & Control	2	VO	3			3	
[C.2.2]	Production Planning & Control	2	UE	2			2	
[C.2.3]	Quality Management	2	VO	3			3	
[C.2.4]	Production Strategies	2	SE	2			2	
Subtotal Compulsory Module C2		**8**		**10**			**10**	
Subtotal C Management and Operations		**19**		**25**	**7,5**	**7,5**	**10**	
Total of Compulsory Modules		**50**		**61**	**30**	**21**	**10**	
Elective Module B3 Advanced Technologies				**10**		**4**	**6**	
Elective Module B4 Laboratory Exercise Advanced Technologies				**3**			**3**	
Elective Module C3 Management and Operations				**10**		**4**	**6**	
Total of Elective Modules described under § 9				**23**		**8**	**15**	
Master's Thesis				**30**				**30**
Elective Courses described under § 10				**6**		1	5	
Overall Total				**120**	**30**	**30**	**30**	**30**

§ 9 Elective modules

For the elective module B3: Advanced Technologies, students have to complete courses worth 10 ECTS credits out of the catalogue of courses below.
An X shows which semester (winter or summer semester) the course is offered in. An X for both semesters means that the course is provided in both semesters (winter and summer semesters).

For the elective module B4: Laboratory Exercise Advanced Technologies, students have to complete courses worth 3 ECTS credits out of the catalogue of courses below. Laboratory courses that exceed the 3 ECTS of the elective module B4 can be chosen as part of the elective module B3 or as free-choice courses.
An X shows which semester (winter or summer semester) the course is offered in. An X for both semesters means that the course is provided in both semesters (winter and summer semesters).

Elective Module Group B: Advanced Technologies						
Elective Module B3: Advanced Technologies						
Course			LV		Semesters	
		SSt.	**Type**	**ECTS**	**WS**	**SS**
[B. 3.1]	Selected Topics Industrial Engineering	2	VU	2	X	X
[B. 3.2]	Factory planning and design	2	VU	2		X
[B. 3.3]	Safety and Sustainability	2	VO	3		X
[B. 3.4]	Modelling and Optimization in Production and Logistic Systems	2	VU	2		X
[B. 3.5]	Warehouse Logistics	1	VO	1.5	X	
[B. 3.6]	Warehouse Logistics	1	UE	1	X	
[B. 3.7]	Selected Topics in Materials, Joining and Forming	2	VU	2	X	X
[B. 3.8]	Materials Selection	2	VU	2	X	
[B. 3.9]	Optimization Methods for Operations Planning	3	VU	3		X
[B. 3.10]	Production Systems	2	VU	2		X
[B. 3.11]	Selected Topics Logistics Engineering	2	VU	2		X
[B. 3.12]	Model Based Product Development	2	VO	3	X	
Elective Module B4: Laboratory Exercises Advanced Technologies						
[B. 4.1]	Design Thinking & Rapid Prototyping	3	LU	3	X	
[B. 4.2]	LEAD Factory	3	LU	3	X	X
[B. 4.3]	Smart Factory	3	LU	3	X	X
[B. 4.4]	Laboratory Logistics Engineering	3	LU	3	X	
[B. 4.5]	Materials Engineering Laboratory	3	LU	3	X	
[B. 4.6]	Engineering Informatics Lab	3	LU	3	X	X

For the elective module C3: Management and Operations, students have to complete courses worth 10 ECTS credits out of the catalogue of courses below.

An X shows which semester (winter or summer semester) the course is offered in. An X for both semesters means that the course is provided in both semesters (winter and summer semesters).

Elective Module Group C: Management and Operations						
Elective module C3: Management and Operations						
Course			LV		Semesters	
		SSt.	**Type**	**ECTS**	**WS**	**SS**
[C. 3.1]	Change Management	1	VO	1.5	X	
[C. 3.2]	Change Management	1	UE	1	X	
[C. 3.3]	Creativity Techniques	2	VU	2	X	X
[C. 3.4]	General Management Case Studies	3	SE	3		X
[C. 3.5]	Leadership and Motivation	2	SE	3	X	X
[C. 3.6]	Operational Risk Management	1	VO	1.5		X
[C. 3.7]	Operational Risk Management	1	UE	1		X
[C. 3.8]	Product Innovation	3	PT	3	X	
[C. 3.9]	Quantitative Methods for Business	2	VO	3	X	X
[C. 3.10]	Quantitative Methods for Business	2	UE	2	X	X
[C. 3.11]	Teambuilding	2	SE	2	X	
[C. 3.12]	Manufacturing and Supply Chain Network	2	VU	2		X
[C. 3.13]	Implementing Innovation Strategy through M&A	2	SE	2	X	
[C. 3.14]	Industrial Energy Management	1	VO	1.5	X	
[C. 3.15]	Industrial Energy Management	1	UE	1	X	
[C. 3.16]	Economic and Ecological Technology Management	2	VU	2	X	
[C. 3.17]	Business Modeling and Simulation	2	VO	3	X	
[C. 3.18]	Business Modeling and Simulation	2	UE	2	X	
[C. 3.19]	Purchasing and Supply Management	3	VO	4.5	X	
[C. 3.20]	Strategic Management	2	VO	3		X

Courses to improve competence in a second language (English or German) can be taken up to a value of 3 ECTS credits.

§ 10 Free-choice Courses

(1) The courses taken as free-choice courses in the master's degree programme Production Science and Management are intended to be used for individual specialization and further development of students and can be chosen freely from the courses offered by recognized universities in Austria and abroad as well as recognized post-secondary educational institutions in Austria or abroad. Appendix II contains recommendations for elective courses.

(2) If a course does not have an allocation of ECTS credits, each semester hour (SSt.) of this course is counted as one ECTS credit. However, if such courses are of the type 'lecture' (VO), 1.5 ECTS credits per semester hour are counted.

(3) Additionally, the possibility exists, in accordance with § 13, to take a professionally-oriented internship or short study periods in foreign countries as part of the free-choice courses [for up to 6 ECTS].

§ 11 Master's Thesis

(1) The master's thesis serves to demonstrate a student's ability to work successfully and independently on a given scientific topic of the study programme in a both scientifically and methodically correct manner. Care should be taken in choosing the topic of the master's thesis to ensure that the thesis can be completed by the student within six months with a reasonable workload.

(2) The topic of the master's thesis should belong to one of the compulsory or elective modules. Any exceptions are subject to approval by the officer responsible for study matters.

(3) The master's thesis must be registered before beginning work on it via the Dean's office with consultation of the office responsible for study matters. The details that should be registered are the topic, the subject that the topic belongs to and the supervisor, stating their institute.

(4) 30 ECTS credits are allocated to the master's thesis.

(5) The master's thesis must be submitted for assessment in both printed and electronic form.

(6) The master's thesis must be written in English.

§ 12 Registration Conditions for Courses/Examinations

The condition for admission to the final master's examination before a committee is proof of positive results in all the assessment measures/examinations as described in § 8 to § 10 and a positive grade for the master's thesis.

§ 13 Foreign Study Periods and Internships

(1) Recommended foreign study periods

It is recommended for students to spend one semester abroad in the course of their studies. In this master's degree programme, the 3rd semester is especially suitable for this purpose. Courses taken during the study period abroad will be recognized by the officer responsible for study matters if they are equivalent. On the recognition of examinations taken during study periods abroad, we refer to § 78 (6) UG (advance decision on equivalence).

It is also possible to obtain recognition of work done in shorter study periods abroad, for example participation in summer or winter schools, as part of the elective courses, by application to the officer responsible for study matters.

(2) Internships/work experience

It is possible to include professionally-oriented internships/work experience in the elective courses, up to an amount of 6 ECTS.

In this case every week of full-time work is counted as 1.5 ECTS credits. Active participation in an academic event/conference is also counted as work experience. This work experience must be relevant to the degree programme and has to be approved by the officer responsible for study matters.

IV Examination Regulations and Conclusion of Studies

§ 14 Examination Regulations

Courses are assessed individually.

(1) The examinations on courses that are lectures (VO) must cover the whole content of the course. Examinations can be oral-only, written-only or a combination of oral and written.

(2) In courses of the types lectures with integrated exercises (VU), exercises (UE), laboratory courses (LU), design exercises (KU), field exercises (FU), projects (PT), seminars (SE), seminar projects (SP) and excursions (EX), students' performance is measured by continuous assessment of work done by the students and/or by ongoing tests. The assessment must be based on at least two evaluations of different aspects of the course.

(3) If a module/a module group is made up of multiple examination results, the overall grade for the module/module group is to be calculated as follows:

a. The grade of each examination belonging to the module/module group is multiplied by the ECTS credits for the corresponding course.

b. The numbers calculated in point a are added together,

c. The result of the addition is divided by the sum of the ECTS credits of the courses, and

d. The result of the division is rounded to a whole number, if necessary. Values after the decimal point that are larger than 0.5 are rounded up and values that are less than 0.5 are rounded down.

e. A positive grade for the module/module group can only be awarded if the grades for each individual examination were all positive.

f. Courses whose assessment consists only of "successful/unsuccessful participation" are not included in the calculation under points a to d.

(4) Regulations on repeating parts of assessments for courses with continuous assessment are set out in the section of the TU Graz statute on ‘Legal Regulations for Academic Affairs’.

(5) The master's examination is held before a committee in English and consists of:

- Presentation of the master’s thesis (max. 15 minutes),
- Defence of the master's thesis (examination discussion with the examination committee, max. 10 minutes),
- An examination on the subject to which the topic of the master’s thesis belongs,
- An examination on one other examination subject as listed in §8 or §9.

The examination subject is selected by the officer responsible for study matters after hearing representations from the candidate, if any. The master’s examination before the committee normally lasts 60 minutes in total and may not exceed 75 minutes.

(6) The examination committee for the mater’s examination includes the supervisor of the thesis and two other members who are nominated by the officer responsible for study matters, after hearing representations from the candidate, if any. The committee shall be chaired by one of the members who is not the supervisor of the thesis.

(7) The grade for this examination before a committee is decided by the examination committee on the basis of the student’s performance in the master’s examination, in accordance with § 24 (6) of the section of the TU Graz statute on ‘Legal Regulations for Academic Affairs’.

§ 15 Conclusion of Studies

(1) The master's degree programme is completed when the student has achieved positive grades for the courses of all compulsory-, elective- and free-choice modules,, the master's thesis and the master's examination before the committee.

(2) The successful completion of the degree programme is documented by issuing a certificate. The final certificate for the master's degree programme in Production Science and Management includes

a. a list of all the modules (module groups) as set out in § 4 (along with their ECTS credits) and their assessment results,
b. the title and grade of the master's thesis,
c. the grade of the final examination before the committee,
d. the total of the ECTS credits of the elective courses as defined in § 10, and
e. the overall grade in accordance with § 11 of the section of the TU Graz statute on 'Legal Regulations for Academic Affairs'.

V Entry into Force and Transitional Regulations

§ 16 Entry into Force

This Curriculum 2020 (TUGRAZonline code 20U) enters into force on October 1st 2020.

§ 17 Transitional Regulations

Students of the master's degree programme in Production Science and Management who are subject to the Curriculum 2007 in the version from 2011 at the time when this Curriculum comes into force on 1.10.2020, are entitled to conclude their studies under the provisions of the Curriculum 2007 in the version from 2011 until 30.9.2023. If they do not complete their degree programme by 30.9.2023, they become subject to the curriculum in its current version. The students may if they wish voluntarily transfer to the new curriculum at any time within the registration period. A written declaration to this effect, which shall be irrevocable, should be addressed to the officer responsible for study matters.

Appendices to the Curriculum of the Master's Degree Programme in Production Science and Management

Appendix I

Module Descriptions and Modes of Assessment

Unless otherwise specified in the module description, the assessment in a module consists of completing all the course examinations planned in the module and all the courses with continuous assessment.

Compulsory Module A	**Basics**
ECTS credits	15
Contents	Methods for technical and economic specification of production systems. This includes manufacturing processes, material aspects, processes and information technologies.
Learning outcomes	After completing this module, students are able to deal with the technical and economic challenges involved in a production system and to integrate important factors into the design.
Teaching and learning activities and methods	Frontal lectures with media support, partly with integrated exercises, exercises and seminars, partly including group exercises.
Recommended conditions for participation	None.
Frequency in which the module is provided	Every academic year

Compulsory Module Group B	Advanced Technologies
Compulsory Module B1	**Factory Planning**
ECTS credits	9
Contents	Methods for planning and calculating material flows and equipment and devices for material flow engineering. Methods for analysis and design of industrial work systems and (fabrication-ready design) design for manufacturing.
Learning outcomes	After completing this module, students are able to design industrial work systems, to create production-line layouts and to carry out the calculations on the production workflow, to analyse and design workplaces in terms of ergonomics and environmental factors, and to develop and design products in such a way that they are ready for manufacturing.
Teaching and learning activities, methods	Frontal lectures with media support, partly with integrated exercises, exercises and seminars, partly with group exercises and reviews of case studies, partly in the Harvard seminar room, and exercises in the teaching factory (LEAD Factory).
Recommended conditions for participation	None.
Frequency in which the module is provided	Every academic year.
Compulsory Module B2	**Automation**
ECTS credits	12
Contents	Methods and concepts for automation of production systems. This includes processes and production and information technologies.
Learning outcomes	After completing this module, students are able to understand methods and concepts of production automation and to apply these in practice.
Teaching and learning activities, methods	Frontal lectures with media support, partly with integrated exercises.
Recommended conditions for participation	Basic knowledge of industrial management and production theory is recommended.
Frequency in which the module is provided	Every academic year

Compulsory Module Group C	Management and Operations
Compulsory Module C1	**Management**
ECTS credits	15
Contents	Methods and concepts of business management, management accounting, and the management of technologies and product innovations. This includes leadership concepts, strategic and operative processes and innovation methods.
Learning outcomes	After completing this module, students are able to apply methods and concepts of business management, management accounting, technology management and product innovation in practice.
Teaching and learning activities, methods	Frontal lectures with media support, partly with integrated exercises, exercises, partly with group exercises, case studies.
Recommended conditions for participation	Basic knowledge of business management and business studies is recommended.
Frequency in which the module is provided	Every academic year
Compulsory Module C2	**Operations**
ECTS credits	10
Contents	Relationships between business and production strategies, fundamentals of the architecture of production systems and network optimization, methods and tools of production planning, production control and quality management.
Learning outcomes	After completing this module, students are able to apply the principles to the design of production strategies, to solve tasks in production planning and production control by developing and using production planning algorithms, and to apply methods and tools of quality management to improve the process compatibility in manufacturing.
Teaching and learning activities, methods	Frontal lectures with media support, partly with integrated exercises and case studies, exercises and seminars, partly with group exercises and review of case studies, partly in the Harvard seminar room.
Recommended conditions for participation.	None.
Frequency in which the module is provided	Every academic year, sometimes in both semesters.

Elective Module Group B	Advanced Technologies
Elective Module B4	**Laboratory Exercise Advanced Technologies**
ECTS credits	3
Contents	Practical application of the material taught in compulsory and free-choice modules in a selected laboratory. Practice-oriented content and applied special topics.
Learning outcomes	After completing this module, students have learned how to apply theoretical principles in practice-oriented, realistic scenarios.
Teaching and learning activities, methods	Laboratory Exercise
Recommended conditions for participation	None.
Frequency in which the module is provided	Every academic year, some courses every semester.
Free-choice module B3	**Advanced Technologies**
ECTS credits	10
Contents	Methods and concepts of production and logistics systems. This includes the design, modelling and optimisation of such systems.
Learning outcomes	After completing this module, students are able to explain, apply and optimize the essential concepts and principles of production and logistics systems.
Teaching and learning activities, methods	Frontal lectures with media support, partly with integrated exercises, exercises
Recommended conditions for participation	Basic knowledge of industrial management and production theory.
Frequency in which the module is provided	Every academic year, some courses every semester.

Elective Module Group C	Management and Operations
Elective Module C3	**Management and Operations**
ECTS credits	10
Contents	Contents in the field of management include basic principles of the essential methods and tools of strategic management, purchasing and supply management, supply chain networks, industrial energy management, business modelling and simulation, risk management and advanced topics in general management, quantitative methods, product innovation, creativity techniques and technology management. Another focus is social sciences with the essential aspects of team building, change management and motivation.
Learning outcomes	After completing this module, students are able to understand the challenges of management and to use methods to solve problems. Students are also able to analyse and design theories about structures and functions within teams and organizations.
Teaching and learning activities, methods	Frontal lectures with media support, partly with integrated exercises and case studies, exercises and seminars, partly with group exercises, and review of case studies, partly in the Harvard seminar room.
Recommended conditions for participation	None.
Frequency in which the module is provided	Every academic year, sometimes in both semesters

Appendix II

Recommended Free-Choice Courses

Free-choice courses can be chosen freely from course provided by recognized universities in Austria and abroad and recognized post-secondary educational institutions in Austria and abroad, as set out in § 10 of this curriculum.

For students to broaden their knowledge in subjects relevant to the modules of this degree programme, courses in the fields of foreign languages, social competence, technological impacts assessment and women's and gender studies are recommended. In particular, we wish to draw attention to the courses offered by the service department Languages, Key Competencies and In-House Training of TU Graz, Treffpunkt Sprachen of the University of Graz, the Centre for Social Competence of the University of Graz and the Science, Technology and Society Unit.

Appendix III

Equivalence List

Courses whose equivalence or recognition is defined in this appendix to the curriculum no longer require individual recognition by the officer responsible for study matters. However, attention is drawn to the possibility of individual recognition by written decision in accordance with § 78 UG.

An equivalence list defines the equivalence of positively completed courses from this present curriculum and the previous curriculum. This equivalence is valid in both directions, i.e. positively completed courses of the previous curriculum are recognized under the current curriculum and positively completed courses of the current curriculum are recognized under the previous curriculum.

Courses that have the same title and are of the same type and have the same number of ECTS credits or the same number of semester hours, are equivalent per se and are not listed in the equivalence list.

Current Curriculum 2020				Previous Curriculum 2007, Version 2011			
Course	**Type**	**SSt.**	**ECTS**	**Course**	**Type**	**SSt.**	**ECTS**
Quantitative Methods for Business	UE	2	2	Quantitative Methods for Business	UE	3	4
Management Control Systems	VO	3	4.5	Controlling	VO	2	3
				Controlling	UE	1	1
Management Control Systems	VO	3	4.5	Controlling (Engl.)	VO	2	3
				Controlling (Engl.)	UE	1	1
Marketing Management	SE	3	3	Marketing Management (Englisch)	VO	2	3
				Marketing Management (Englisch)	UE	1	1
Marketing Management	SE	3	3	Marketing Management	VO	2	3
				Marketing Management	UE	1	1
Rhetoric and Presentation	SE	2	2	Rhetoric und Presentation (Engl.)	VO	1	1
				Rhetoric und Presentation (Engl.)	UE	1	1
Rhetoric and Presentation	SE	2	2	Rhetoric und Presentation	VO	1	1
				Rhetoric und Presentation	UE	1	1
Enabling Innovation	VO	1	1.5	Product Innovation Management	VO	1	1.5
Enabling Innovation	UE	1	1	Product Innovation Management	UE	1	1.5
Creativity Techniques	VU	2	2	Creativity Techniques	VO	1	1.5
				Creativity Techniques	UE	1	1
Product Innovation	PT	3	3	Product Innovation Project 1	PR	3	5
Technology Management	VO	2	3	Technology Management	SE	2	2
General Management, Case Studies	SE	3	3	General Management, Case Studies	VO	1	1.5
				General Management, Case Studies	UE	2	2

Recognition List

For students of the master's degree programme Production Science and Management at Graz University of Technology the following regulations apply to the recognition of courses:

If students transfer into the current curriculum, the examinations they have completed previously for courses from the 2007 curriculum for the master's programme in Production Science and Management in the version from 2011 are recognized according to the listing below. After transferring into the current curriculum, they are only allowed to take examinations from this curriculum.

- Compulsory and elective subjects of the advanced topics module 'Advanced Technologies' from the 2007 curriculum for the master's programme in Production Science and Management in the version from 2011 are recognized in the current curriculum in the elective module B3.
- Compulsory and elective subjects of the advanced topics module 'Management and Social Economics' from the 2007 curriculum for the master's programme in Production Science and Management in the version from 2011 are recognized in the current curriculum in the elective module C3.

Appendix IV.

Course Types

At TU Graz the following types of course are provided, in accordance with § 4 (1) of the section of the TU Graz statute on 'Legal Regulations for Academic Affairs'. The course types listed under numbers (2) to (12) are courses with continuous assessment.

(1) VO … Lecture: Lectures introduce students in a didactically well-prepared manner to parts of the subjects and the relevant methods. The contents and methods of a subject are presented in a talk.
(2) UE … Exercise: Exercises are designed to develop the students' abilities to apply the subject matter to specific problems.
(3) KU … Design exercise: Design exercises are used to achieve a deeper and/or expanded understanding of the subject matter taught in lectures by doing design work, building skills and competences in a context of academic-professional training. Special equipment and/or specially equipped workspaces are needed.
(4) LU … Laboratory course: Laboratory courses are used to achieve a deeper and/or expanded understanding of the subject matter taught in lectures by doing practical, experimental and/or design work in a context of academic-professional training with especially close supervision. An essential component of laboratory courses is the creation of records of the work carried out.

(5) PT … Project: In projects, students carry out experimental, theoretical and/or design or applied work or small pieces of research work including all necessary work steps. Projects conclude with a written report which forms part of the assessment. Projects can be done as teams or as individuals. Projects done in teams must be organized in such a way that it remains possible to assess the individual performance of each student.

(6) VU … Lecture with integrated exercise: Lecture with integrated exercise (VU) include both lectures presenting parts of the subject and its methods, and instructions for autonomous learning or autonomous application of knowledge in examples.

(7) SE … Seminar: Seminars are used for presenting scientific methods, for development and critical discussion of students' own work or specific fields of the literature and for practicing discussion of the subject. Written work is prepared, presented and discussed.

(8) SP … Seminar project: In seminar projects, students use scientific methods to work on experimental, theoretical and/or applied design problems or carry out small research projects including all necessary work steps. Seminar projects are concluded with a written report and an oral presentation, which form part of the assessment. Seminar projects can be done as teams or as individuals. Projects done in teams must be organized in such a way that it remains possible to assess the individual performance of each student.

(9) EX … Excursion: Excursions help to demonstrate the contents of other course types in reality by visiting practical instances of the subject matter at locations outside the university premises.

(10) OL … Orientation course: Orientation courses are an opportunity to pick up information and an overview of the degree programme.

(11) PV … Exclusive tutorial: The exclusive tutorial is a research seminar that takes place in the course of doctoral studies.

(12) FU … Field exercises: Field exercises take place outside the premises of TU Graz in the open air (e.g. on the street, on construction sites, in alpine terrain, in forests, in tunnels) and partly in inclement weather conditions. The students carry out the tasks of the exercise essentially autonomously, after suitable preparation.