

Appendix

Double Degree Agreement on Master's level in Material Science between JUSTUS LIEBIG UNIVERSITY GIESSEN, GERMANY, Faculty of Biology and Chemistry and Faculty of Mathematics, Computer Science, Physics, Geography and UNIVERSITY OF PADOVA, Department of Chemical Sciences

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1. Aims:

Based on the agreement of Justus Liebig University (JLU) and Padua University (UNIPD) both universities establish a double degree programme on Master's level in Material Science. The programme provides the opportunity for master students of Material Science at JLU and for master students of Materials Science of the Department of Chemical Sciences at UNIPD to gain the Master's degree of both universities: the "Master of Science" of JLU and the "Laurea Magistrale in Material Sciences" of UNIPD.

2. Master's programmes:

The double degree programme is based on the following two Master's programmes. In case of changes to any of these programmes (i.e., due to reaccreditation) both parties agree to inform each other in time and – if necessary – adapt this appendix to the changes:

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The **JLU Master's programme in Material Science** is commonly taught by Faculty 07 – Mathematics, Computer Science, Physics, Geography and Faculty 08 - Biology and Chemistry at the JLU. The 2 years long MSc programme (i.e., 4 semesters) can be started at both, the winter and summer semester. The first year includes core modules in each subject, chemistry and physics. Within the first year, one elective module in chemistry and one in physics have to be taken, out of a pool of courses offered by physics and chemistry. Furthermore, the first year contains two optional modules, i.e., they can be taken from other disciplines than chemistry and physics. The second year is entirely devoted to research work. Students choose 3 research modules (2 for in-depth research and 1 for specialisation). The Masters' programme will be completed by submitting the Master's thesis and defending its results in front of an examination committee.

On successful completion of the programme, both faculties jointly confer the award of "Master of Science" (M.Sc.). Students receive a Master's certificate and a Certificate of Examination including Master's classification¹ and Diploma Supplement. Titles of all modules passed, workload and grading as well as the title of Master's thesis and grading are included in these documents.

The Masters' programme itself is structured in modules. Modules are units of lectures, practical work, seminars, tutorials etc. dedicated to a specified topic (e.g. electrochemistry, solid state theory). Each module is described in detail by its content, aims, workload, types of exams, responsible lecturer etc. and is listed in the "Module descriptions" attached to the Special Regulation for the Master's programme in material science. Every module of the Master's programme in material science is graded by grade points (see: grading scheme).

In general, there are two different types of modules:

- **Lecture-based modules:** These modules typically include a lecture (running for 15 weeks = 1 semester) and a seminar or a theoretical/practical exercise run by tutors. Thus, these modules can typically be finished completely within 4-5 months. Marks will be given on the basis of either a written or oral exam at the end of the module. The subjects of the modules typically represent important fields in science and technology, i.e. colloid chemistry, electrochemistry, photovoltaics etc. During the first year, JLU students choose 4 of these advanced modules in chemistry and 4 in physics. Additionally, they follow their own interests by choosing 2 elective modules (6 CP each).
- **Research modules:** These modules are exclusively research-based, and the modules are defined on an individual basis – depending on the research profile of the respective master student. The student can either take part in ongoing research or can be trained in a specific scientific method (e.g. a specific analytical method). At JLU students select three research modules during the second year: two in-depth research modules in material science-oriented chemistry and physics and one specialisation research module for preparing their Master thesis (10 CP each).

In accordance with the European Credit Transfer System (ECTS), the volume of learning activities (workload) required for achieving the Master's degree in material science equals 120 CP (ECTS Credit Points), i.e. 30 CP per semester / 60 CP per year. 1 CP is equivalent to an average working time of 30 hours. This includes contact time at which students have to be present at lectures, seminars, tutorials, practical work etc. and time for preparation and post-processing. Finally, this also includes time for self-study and examinations.

Each first year lecture-based module comprises 6 CP corresponding to 180 hours working time. The second year research modules comprise 10 CP each (i.e. 300 h). Preparing and defending the Master's thesis is equivalent to 30 CP (i.e. 900 h / 22 weeks).

¹ The M.Sc. award is classified according to an overall grading. The overall grade is calculated by dividing the total weighted grade points (grade points for each module multiplied by the credit points allocated to the module) by the total number of credit points.

JLU M.Sc. Material Science Schedule:

MSc in Advanced Materials @JLU

Planned start: winter semester 2018/19

		Master Thesis (30 CP)						
		Choice of specialization research module, in the field of the thesis module						
		Laboratory Project in Organic Chemistry (10 CP)	Laboratory Project in Inorganic Chemistry (10 CP)	Physical Chemistry Project (10 CP)	Multi Functional Semiconducting Thin Films (10 CP)	Applied Materials Physics (10 CP)	Band Structure Methods (10 CP)	
		Choice of in-depth research modules, 1 in chemistry, 1 in physics						
		Advanced Organic Chemistry Laboratory Course (10 CP)	Inorganic Chemistry, Advanced Synthesis and Characterization (10 CP)	Physical Chemistry and Materials Research (10 CP)	Characterization of Semiconductors (10 CP)	Surface and Interface Technologies (10 CP)	Project: Theoretical Methods in Materials Science (10 CP)	
1 Year	Winter	Solid State and Materials Chemistry (6 CP)	Organic Materials (6 CP)	Physical Chemistry (6 CP)	Elective Module physics (6 CP)	Elective Module chemistry (6 CP)	Optional Module (6 CP)	Solid-State Theory (6 CP)
	Summer					at least 1 elective module in chemistry, and at least 1 in physics; these four modules are not attributed to winter or summer semester, i.e. the student is free to choose, only depending on when the modules are offered.		Physics of Semiconductors (6 CP)

Comment: the MSc program can be started in winter or summer semester

The **UNIPD Master's programme in Materials Science** provides training in the advanced methods and techniques for the design, synthesis and characterization of innovative functional (nano)materials. An interdisciplinary approach combining lectures and practical lab sessions is followed. Students broaden their knowledge on the most advanced topics in Chemistry, Physics and Engineering of Materials through core contents (64 ECTS) and a selection of courses (18 ECTS) allowing them to tailor the program to meet their personal interests. Finally, students will complete their Master Degree by undertaking an original research project (38 ECTS) under the supervision of tutors from one of the three Departments contributing to the Course: Dept. of Chemical Sciences, Physics and Astronomy or Engineering.

Course Syllabus: <http://didattica.unipd.it/off/2017/LM/SC/SC1174>.

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M.Sc. Materials Science Schedule:

I semester (October, 1 – Last Week of January)			
Course Name	ECTS	Type	Language
Physical Chemistry of Materials	6C	Core	IT
Physics and Technology of Semiconductors	8 (6C+2E)	Core	IT
Functional Organic Materials	6 (5C+1E)	Core	EN
Physical Methods for the Characterization of Materials with Lab	10 (5C+1E+4L)	Core	IT
II semester (March, 1 – Second Week of June)			
Course Name	ECTS	Type	Language
Lab of Preparation and Characterization of Materials II	10 (1C+1+8L)	Core	IT
Fundamentals of Nanoscience	8 (7C+1L)	Core	IT
Surface Structure & Dynamics	6C	Core	IT
Computational Methods in Materials Science Superconducting Materials Materials for Energetics Inorganic Functional Materials	6C	Optional	IT/EN
III semester			
Course Name	ECTS	Type	Language
Technology of Materials	6 (5C+1E)	Core	IT
Electrochemistry of Materials Optics of Materials (Materials Science) Nanofabrication (Material Science) Optics and Physics of Lasers	6C	Free Choice 1	IT/EN
Any of the above, or courses offered by other MDs	6C	Free Choice 2	IT/EN
Patens and Product Development	2C	Core	IT
Educational Internship (initial part of the thesis internship)	2L	Core	IT/EN
Master thesis internship (beginning)	8L	Core	IT/EN
IV semester			
Course Name	ECTS	Type	Language
Master thesis internship (end)	30L	Core	IT/EN

C - Classroom teaching (1 ECTS = 8 hours); E - Exercises (1 ECTS = 10 hours); L - Laboratory (1 ECTS = 12 hours)

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3. Double Degree Programme

CONDITIONS TO OBTAIN THE DOUBLE DEGREE

The double degree agreement is based on a mutual recognition of the activities that students undertake at their Home Institution (UNIPD or JLU) prior to the mobility abroad.

Students will follow a studying programme consisting of 2 semesters at the home institution and 2 semesters abroad at the host institution, according to the following study plan:

Table 1.- Structure of the Study Plan in order to obtain a double degree

Home Institution	1 st year	2 nd year First semester	2 nd year second semester for Master Thesis	Total credits to obtain the DD
UNIPD	60	20	40	120
JLU	60	30	30	120

Requirements for awarding a Master's degree of JLU and of UNIPD in the framework of the double degree programme:

- Students have to complete a one year study stay at the partner university. During this time they have to pass all courses, seminars, lectures, classes or others (hereinafter referred to as modules) defined in the working plan mutually agreed upon by the academic coordinators at JLU and UNIPD. The working plan shall contain the typical workload per year at the partner university: i.e. at JLU 60 CP in total, at UNIPD 60 credits in total. Therefore, each university offers a defined set of modules taught in English. These modules should be fully accepted by both universities. An updated list has to be provided by both universities regularly.
- Furthermore, a master thesis has to be prepared, preferentially under joint supervision by professors from both universities. It has to be successfully defended in front of an examination committee.

Schedule for Students' Exchange:

JLU students of the Masters' programme in Material Science start their studies at JLU (semester 1: October – March, semester 2: April - September). During the first two semesters, they have to successfully participate in 10 lecture-based modules (60 CP in total). Afterwards, from semester 3 on, they spend a one year study stay at the UNIPD Department of Chemical Sciences where they have to obtain the typical workload of 60 credits including their master thesis.

UNIPD students of the Masters' programme in Materials Science start their studies at UNIPD. During the first two semesters, they have to successfully participate in courses totalling 60 credits. Afterwards, from semester 3 on (semester 3: October – March, semester 4: April - July), they spend a one year study stay at the JLU where they have to obtain the typical workload of 60 CP including their master thesis.

4. Master thesis

The master thesis should be written under the joint supervision of both universities and has to be defended in front of an examination committee. This committee must include at least one member from each university. It has to be submitted in English on schedule at the students' host university. The outcomes of the master thesis have to be defended in English in front of an examination committee.

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5. Application and Entry Requirements

Admission procedures to the double degree programme are carried out by the home universities. At the same time, the host university reserves the right for making the final decision.

Both universities should nominate students of their Master's programmes. A maximum number of 5 students can be proposed per year.

As the entire study stay at the partner university will be conducted in English, knowledge of written and spoken English is required. Applicants must provide a certificate giving evidence of their proficiency in English. The following are accepted as evidence:

- 80 (iBT – internet based) in the TOEFL (Test of English as a Foreign Language)
- 6 points in the IELTS Academic Test (International English Language Testing System)
- a Bachelor's degree course completed in English
- another approved English competency test (e.g. DAAD vd2, UNICert II B2, any B2 equivalent)

Master students who are admitted to the JLU Master's programme in Material Science or the UNIPD Masters' programme at the Department of Chemical Sciences are eligible to apply for the double degree programme. At the beginning of their second semester, applicants have to submit the following documents (in English) to the academic coordinator of their home university:

- Bachelor's Certificate
- Letter of motivation
- Study plan accepted by the academic coordinators of both universities
- an approved English competency test (see above).

Additionally, at selection stage, UNIPD students and JLU students must have successfully participated in all first semesters' modules having obtained at least 20 ECTS.

Students may also be admitted to the programme on the basis of interviews guided by the academic coordinator of their home university.

Based on the requirements and procedures mentioned above and based on academic merits, both universities should nominate students as candidates for the programme.

Following partner universities' academic coordinators' approval (including confirmation of study plan and supervision) students are provisionally admitted to the double degree programme by their home university.

Selected students will be finally admitted to the host institution only after completing their first year of studies for at least 48 ECTS at the home institution before their mobility period.

6. Language

Studying during the study stay at the partner university is carried out in English. The Master thesis has to be written and defended in English.

7. Workload Approval and Grading Scheme

It is agreed that mutual recognition of the period of studies at the partner university is guaranteed. The workload will be calculated on the basis of the guidelines of the participating universities. At the JLU the basis for recognition is the Special Regulation for the programme in Material Science leading to the Master of Science degree at

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JLU.² At UNIPD, general regulations pertaining to study programmes are specified in the University Teaching Regulations ("*Regolamento Didattico di Ateneo*"). Workload approval at UNIPD:

Workload Approval:

Gaining the Master's degree of JLU and of UNIPD in the framework of the double degree programme requires that students pass modules (i.e. courses) to the extent of a typical one year workload at the partner university: at JLU 60 CP in total, at UNIPD 60 credits in total.

Mutual recognition of study periods (modules/courses resp. CP/credits) is implemented on the basis of the following tables which contain a comparison of workload at JLU and UNIPD.

Workload approval at JLU:

	JLU	UNIPD
	Modules (CP)	Courses (credits)
1. Year		
	Physical Chemistry (6)	Physical Chemistry of Materials (6)
	Organic Materials (6)	Functional Organic Materials (6)
	Physics of Semiconductors (6)	Physics and Technology of Semiconductors (8)
	Elective Module Physics (6) Optional Module 1 (6)	Physical Methods for the Characterization of Materials with Lab (10)
	Elective Module Chemistry (6) Solid State and Materials Chemistry (6)	Lab of Preparation and Char. Of Materials II (10)
	Physics of Surfaces and Interfaces (6)	Surface Structure & Dynamics (6)
	Fundamentals of Solid State Theory (6)	Fundamentals of Nanoscience (8)
	Optional Module 2 (6)	Optional Course (6)
3. Semester		
	In-depth research module 1 (10)	Technology of Materials (6/6) Educational Internship (2/2) Patents and Products Development (2/2)
	In-depth research module 2 (10)	Free Choice (10/6 +6)
	Specialisation research module (10)	Master thesis internship (10/8)
4. Semester		
	Master thesis (30)	Master thesis (30/30)
	120 CP	120 CP

² https://www.uni-giessen.de/cms/mug/7/findex36.html/7_36_07_1_M

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Workload approval at UNIPD:

	UNIPD	JLU
	Courses (credits)	Modules (CP)
1.Year		
	Physical Chemistry of Materials (6)	Physical Chemistry (6)
	Functional Organic Materials (6)	Organic Materials (6)
	Physics and Technology of Semiconductors (8)	Physics of Semiconductors (6)
	Physical Methods for the Characterization of Materials with Lab (10)	Elective Module Physics (6) Optional Module 1 (6)
	Lab of Preparation and Char. Of Materials II (10)	Elective Module Chemistry (6) Solid State and Materials Chemistry (6)
	Surface Structure & Dynamics (6)	Physics of Surfaces and Interfaces (6)
	Fundamentals of Nanoscience (8)	Fundamentals of Solid State Theory (6)
	Optional Course (6)	Elective Module 2 (6)
3. Semester		
	Technology of Materials (6/6) Educational Internship (2/2) Patents and Products Development (2/2)	In-depth research module 1 (10)
	Free Choice (10/6 +6)	In-depth research module 2 (10)
	Master thesis internship (10/8)	Specialisation research module (10)
4.Semester		
	Master thesis (30/30)	Master thesis (30)
	120 CP	120 CP

Comparative Grading Scheme:

All work performed within modules shall be graded in accordance with the grading scheme applicable at the universities in question.

For the evaluation of the Masters' thesis students receive one grade of each grading scheme: one grade from UNIPD and one grade from JLU by the supervisors of the respective university.

Comparative table of JLU/UNIPD module grades:

JLU		Percentages for the evaluation of module examinations (%)	UNIPD	
Grade points	Verbal grades		Grades	Verbal grades
15	very good with distinction	≥97	30 e lode	
14	very good	≥92	30	
13	very good	≥87	28-29	
12	Good	≥82	27	
11	Good	≥77	26	
10	Good	≥73	24-25	
9	satisfactory	≥68	23	
8	satisfactory	≥64	22	
7	satisfactory	≥59	20-21	
6	sufficient	≥54	19	
5	sufficient	≥50	18	
4	Fail	≥45	16-17	
3	Fail	≥38	14-15	
2	Fail	≥32	12-13	
1	Fail	≥21	8-11	
0	Fail	≥0	0-7	

For approval of workload and grading a summary table should be provided in English for each student by the corresponding university. The summary table should also contain the title of the modules, workload and the grades (Transcript of Records). In order to arrive at the overall grade, the module grades at JLU should be converted into UNIPD grades and vice versa in accordance with the table presented above.

8. Master's Certificate

Students who meet academic requirements (provided that no module is finally failed) in the framework of the double degree programme should be awarded two Master's Certificates: a Master's certificate of JLU („Master of Science“) and a Master's certificate of UNIPD („Diploma di Laurea Magistrale in Material Sciences“). Both certificates must refer to the bilateral double degree programme. Students also receive a Certificate of Examination including Master's classification. Both universities provide Diploma Supplements.

9. Academic coordination

To ensure and facilitate the implementation of the double degree programme, each institution shall appoint an academic coordinator as contact person. The coordinators can be addressed by students, JLU and UNIPD colleagues of the double degree programme. Besides admitting applicants they are authorized persons for accepting students' study plans and workload approval.

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List 1 (JLU)

Faculty members and professors teaching in materials science:

Full professors can be chosen as thesis advisors; all listed faculty members offer research-based courses.

Faculty/Advisor	Institute	Research subjects (for the definition of research projects at JLU)
Prof. Dr. M. Dürr	Applied Physics	Surface science, Surface spectroscopy, mass spectrometry
Dr. M. Elm	Phys. Chem./Physics	Magnetic materials for spintronics, nanostructured magnetic and ionic materials
Prof. Dr. C. Heiliger	Theoretical Physics	Computer-based modeling and simulation of functional materials, semiconductors, thermoelectrics
Dr. D. Hofmann (apl.-Prof.)	Solid State Physics	Semiconductors
Prof. Dr. J. Janek	Physical Chemistry	Solid state ionics, fuel cell materials, battery materials, mixed conductors, solid state electrochemistry
Prof. Dr. P. J. Klar	Solid State Physics	Nano- and microstructured materials, semiconductors,
Dr. R. Marschall	Physical Chemistry	Photoelectrochemistry, materials for solar harvesting
Prof. Dr. A. Müller	Inorganic Chemistry	Thermoelectric materials
Dr. A. Polity (PD)	Solid State Physics	Thin films and thin film deposition, sputtering
Prof. Dr. Z. Mitic	Plasma Physics	Plasma techniques for materials science
Prof. Dr. D. Mollenhauer	Theoretical Chemistry	Computer-based modeling of interfaces and surfaces
Prof. Dr. H. Over	Physical Chemistry	Surface science, heterogeneous catalysis, electrocatalysis, surface analysis
Prof. Dr. S. Schindler	Inorganic Chemistry	Complex chemistry
Prof. Dr. A. Schirmeisen	Applied Physics	Surface science, scanning probe microscopy
Prof. Dr. D. Schlettwein	Applied Physics	Hybrid materials, photochemistry, photovoltaics, photoelectrochemistry, organic semiconductors
Prof. Dr. P. R. Schreiner	Organic Chemistry	Synthesis of organic molecules, computational chemistry
Prof. Dr. B. Smarsly	Physical/Inorg. Chemistry	Nanostructured materials, porous materials, materials for catalysis and sensing
Dr. J. Teubert	Solid State Physics	Semiconductor physics
Prof. Dr. M. Thoma	Plasma Physics	Plasma-based techniques
Prof. Dr. R. Göttlich	Organic Chemistry	Synthesis, photoactive compounds and materials
Prof. Dr. H. Wegner	Organic Chemistry	Carbon-based materials, synthesis