Technische Universität Braunschweig

SPECIAL PART OF THE EXAMINATION REGULATIONS FOR THE

MASTER'S PROGRAMME SOLAR SYSTEM PHYSICS

AT THE
TECHNISCHEN UNIVERSITÄT BRAUNSCHWEIG

OF THE
FAKULTÄT FÜR
ELEKTROTECHNIK, INFORMATIONSTECHNIK, PHYSIK

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Special Part of the Examination Regulations for the Master's Programme Solar System Physics at the Technische Universität Braunschweig

The Faculty Council of Fakultät für Elektrotechnik, Informationstechnik, Physik (FK EITP) has decided on 23.01.2023 and the deanery has decided in urgent compentence on 14.09.2023 in addition to the regulation of the general part of the examination regulations for the Bachelor's, Master's, Diploma and Magister degree programmes of the Technische Universität Braunschweig (APO) the following special part of the examination regulations for the Master's degree programme Solar System Physics.

§ 1 – Subject matter and standard period of study

(1) These examination regulations govern the Master's degree programme Solar System Physics of the Fakultät für Elektrotechnik, Informationstechnik, Physik, in particular the examination procedure, study regulations and provisions.

(2) The period of study in which the degree programme can be completed is 4 semesters (standard period of study).

§ 2 - University Degree and Certificate

(1) After passing the Master's examination (cf. § 4), the TU Braunschweig awards the degree of "Master of Science" (abbreviated to "M.Sc."). The TU Braunschweig issues a certificate in German and in English with the date of the certificate in accordance with the model of the APO.

(2) In addition, a certificate and a Diploma Supplement are issued in German and in English according to the models in the appendices of the APO, taking into account the components specific to the degree programme. The programme-specific components of the Diploma Supplement are listed in Annex 1.

(3) In addition to the overall grade according to § 16 (2) APO, the grades of the individual modules with their credit points (CP) are listed in the transcript. Ungraded modules are only listed with their credit points. The grade "passed with honours" is awarded for a grade point average up to and including 1.1 as part of the calculation of the overall grade.

§ 3 - Structure and scope of the degree programme

(1) The Master's degree programme in Solar System Physics begins in the winter and summer semesters.

(2) The study programme is organised in modules and comprises a total of 120 credit points.

(3) The study programme is divided into the parts "Specialised in-depth phase" (60 LP) and "Research phase" (60 LP).

(4) In the specialised deepening phase, which consists of three compulsory modules and one compulsory elective module, at least 60 LP must be acquired as follows:

Module	**CP**
Planetary Bodies	15
Solar System	15
Hands-On Solar System Physics	15

In the compulsory elective area "Special Courses", modules amounting to at least 15 CP must be completed. For this purpose, at least three modules from the modules listed in the compulsory elective area "Special Courses" (Annex 2) must be taken.

(5) In the research phase, 60 CP must be proven as follows:

Module	**CP**
Scientific Key Qualifications	10
Literature Research	5
Research Internship	15
Master Thesis	30

§ 4 - Examination and study achievements

(1) The Master's examination consists of the subject examinations of the modules and the Master's thesis.

(2) The modules, qualification objectives, type and scope of the assigned examination or study achievements and the number of assigned credit points are specified in Annex 1. The examination contents result from the qualification objectives of the modules. For their interpretation, the professional requirement may also be used as an alternative.

(3) The provisions of the APO, as amended from time to time, shall apply to the registration, admission, performance and repetition of examinations.

(4) The language of the courses and examinations is generally English. If the course, together with the examination language and examination modalities, is marked as a German-language course in the course catalogue and the module handbook, the course and examination language shall be German. Students have the option of submitting an informal application for an English-language examination to the examination board up to three weeks before the examination date at the latest.

(5) In addition to § 9 (1) of the APO, the following examination and study achievements shall be included:

a) Homework: In homework, subject-specific tasks set by the lecturer in the context of an exercise are worked on independently and in writing by the students and, if necessary, explained orally. Homework can be completed in classroom lectures or in self-study and can also contain programming components. The criteria for successful completion are announced by the lecturer at the beginning of the course.

b) Internship protocol: An internship protocol comprises the description of the structure, implementation and result of an internship carried out, including and evaluating relevant literature. Type and scope are announced at the beginning of the course.

§ 5 - Mentoring system

(1) Each student is assigned a professor as mentor at the beginning of the programme. The change of a mentor is possible at the request of one of the participants.

(2) In the course of the Master's programme, preferably in the first semester, each student must have at least one counselling interview with his or her mentor. The mentor shall issue a certificate of participation in the respective counselling interview, which must be

submitted to the examination office by the end of the semester in question.

(3) If less than 30 CP have been achieved by the end of the second semester of study, a further mentoring interview will take place as a compulsory counselling interview in the sense of § 8 (2) APO. In deviation from § 8 (2) P. 2 APO, proof of participation is not a prerequisite for admission to further study and examination achievements.

§ 6 - Master Thesis

(1) The Master Thesis is the final thesis according to § 14 APO. It shall show that the student is able to work on a scientific problem from his/her subject within a given period of time under the guidance of a supervisor and to present the results appropriately.

(2) The candidate shall be given the opportunity to make suggestions for the topic of the Master's thesis.

(3) The topic of the Master's thesis can be assigned by the members of the university teaching staff and the full-time non-scheduled professors and private lecturers of the faculty who represent the subject Solar System Physics. The subject Solar System Physics is represented by those who are active as lecturers in one of the modules of the specialised deepening phase according to § 3 (4), or who were active in the past 3 years before registration of the topic of the Master's thesis. The topic can also be issued by retired professors of the faculty who represent the subject Solar System Physics. With the consent of the examination committee, the topic may also be issued by other persons authorised to conduct examinations according to § 5 (1) APO. The examiner who has issued the topic (first examiner) is also the supervisor of the thesis. In the case of sentence 3 or sentence 4, the second examiner must be a full-time professor of the faculty and represent the subject Solar System Physics.

(4) Students who have completed at least 60 CP of examinations and study achievements and have been definitively admitted to the Master's degree programme may be admitted to the Master's thesis upon application. The examination board may allow the Master's thesis to be admitted even if less than 60 CP have been completed.

(5) The time from the issue of the topic to the submission of the Master's thesis is a maximum of eight months. The topic can only be returned once and only within the first third of the processing time according to sentence 1. Upon justified application, the examination board may exceptionally extend the processing time by up to 2 months in individual cases.

(6) Only an original thesis may be submitted as a Master's thesis, i.e. a thesis written by the student him/herself, which - also in parts - has not yet been presented in another examination (also not in other departments or faculties).

(7) The Master's thesis shall be written in English. Languages deviating from this may be approved by the examination committee upon application if this appears appropriate due to the topic and/or the person of the examiners. In this case, a summary in English must be included.

(8) The Master's thesis must be submitted in due time.

(9) The Master's thesis is to be evaluated independently by two examiners. If the evaluations of the Master's thesis differ from each other by a grade of 2.3 or more, the examination committee shall request the examiners to reconsider the evaluation of the Master's thesis.

§ 8 - Calculation of the overall grade

(1) The overall grade is calculated as the weighted average of the graded modules according to § 12 (1 – 4) APO. If the overall grade is up to and including 1.1, the grade "with honours" shall be awarded.

§ 9 - Part-time study

(1) In accordance with § 22 of the Matriculation Regulations, the Master's degree programme is suitable for part-time study. Thus, a maximum of 15 credit points can be acquired semester by semester. The application for admission to part-time studies must be addressed to the Admissions Office and must be accompanied by an individual study plan, which must be confirmed by signature of the chairperson of the examination board or a person appointed by him/her. It should be noted that in particular practical courses and experimental exercises that take place over a period of one or more weeks must be attended throughout the entire working day.

§ 10 - Entry into force

(1) These examination regulations shall enter into force on 01.10.2023.

Annex 1

Diploma Supplement – Studiengangsspezifische Bestandteile

2. ANGABEN ZUR QUALIFIKATION
2.1 Bezeichnung der Qualifikation und (wenn vorhanden) verliehener Grad (in Originalsprache)
Master of Science (M. Sc.)

2.2 Hauptstudienfach oder –fächer für die Qualifikation
Physik

2.3 Name und Status (Typ/Trägerschaft) der Einrichtung, die die Qualifikation verliehen hat (in Originalsprache)
Technische Universität Carolo-Wilhelmina zu Braunschweig
Fakultät für Elektrotechnik, Informationstechnik, Physik

Universität/Staatliche Einrichtung

2.4 Name und Status (Typ/Trägerschaft) der Einrichtung (falls nicht mit 2.3 identisch), die den Studiengang durchgeführt hat (in Originalsprache)
(wie 2.3)

2.5 Im Unterricht / in der Prüfung verwendete Sprache(n)
Englisch

3. ANGABEN ZU EBENE UND ZEITDAUER DER QUALIFIKATION
3.1 Ebene der Qualifikation
Master-Studium, forschungsorientiert

3.2 Offizielle Dauer des Studiums (Regelstudienzeit) in Leistungspunkten und/oder Jahren
Zwei Jahre (inkl. schriftlicher Abschlussarbeit), 120 ECTS-Leistungspunkte

3.3 Zugangsvoraussetzung(en)
Bachelor in Physik oder vergleichbarer Abschluss im selben oder thematisch ähnlichen Gebiet

2. INFORMATION IDENTIFYING THE QUALIFICATION
2.1 Name of qualification and (if applicable) title conferred (in original language)

Master of Science (M. Sc.)

2.2 Main Field(s) of study for qualification
Physics

2.3 Name and status of awarding institution (in original language)

Technische Universität Carolo-Wilhelmina zu Braunschweig
Fakultät für Elektrotechnik, Informationstechnik, Physik

University/State institution

2.4 Name and status of institution (if different from 2.3) administering studies (in original language)
(same as 2.3)

2.5 Language(s) of instruction/examination
English

3. INFORMATION ON THE LEVEL AND DURATION OF THE QUALIFICATION
3.1 Level oft the qualification
Master´s degree (graduate/second degree), by research with thesis

3.2 Official duration of programme in credits and/or years

Two years (120 ECTS credits)

3.3 Access requirement(s)
Bachelor Degree in Physics or equivalent degree (three or four years) in the same or closely related field

Diploma Supplement – Studiengangsspezifische Bestandteile

4. ANGABEN ZUM INHALT DES STUDIUMS UND ZU DEN ERZIELTEN ERGEBNISSEN

4.1 Studienform
Vollzeitstudium

4.2 Lernergebnisse des Studiengangs
Der Masterstudiengang „Solar System Physics" an der Technischen Universität Braunschweig ist forschungsorientiert und gekennzeichnet durch seine wissenschaftliche Ausrichtung mit dem inhaltlichen Schwerpunkt Sonnensystemphysik. Der zweijährige Masterstudiengang führt die Absolventinnen und Absolventen zur Berufsqualifikation als Sonnensystemphysikerin bzw. Sonnensystemphysiker mit einer am internationalen Spitzenniveau orientierten Qualifikation. Hauptziel ist daher die Befähigung zum selbständigen Arbeiten an der Spitze der physikalischen Forschung rund um das Thema Sonnensystemphysik.
Dies beinhaltet sowohl eine weitere fachliche Vertiefung als auch die Erarbeitung der für das Berufsbild der Physikerin und des Physikers, spezialisiert auf die Physik des Sonnensystems, wichtigen strategischen und praktischen Kompetenz.
Im Masterstudium ist das Heranführen an die Praxis des innovativen Arbeitens in der Wissenschaft sowie die Einübung in die Praxis des Problemlösens angesichts hochgradig komplexer Fragestellungen im modernen Technik- und Wirtschaftsleben gleichberechtigt neben einer weiteren fachlichen Vertiefung des Wissens zu sehen.
Ein wesentliches Element der Ausbildung im Masterstudiengang Solar System Physics ist die Forschungsphase. Sie dient dem Erlernen selbständigen wissenschaftlichen Arbeitens. Neben einem Einführungsprojekt zum wissenschaftlichen Arbeiten ist ihr zentrales Element die Masterarbeit. In dieser Phase ist die wissenschaftliche Forschung untrennbar verbunden mit dem Erwerb von Schlüsselqualifikationen wie zum Beispiel Projektmanagement, Teamarbeit und wissenschaftliche Kommunikation.
Insbesondere befähigt der Masterstudiengang zu eigener Forschung im Rahmen einer Dissertation in der Physik. Absolventinnen und Absolventen des Masterstudiengangs verfügen über Problemlösungskompetenz und setzen diese mit ihrem Fachwissen um. Ihr interdisziplinäres Wissen befähigt sie darüber hinaus, im späteren Berufsleben Projektleitungsaufgaben zu übernehmen oder z.B. eine Karriere im Management zu durchlaufen.

4.3 Einzelheiten zum Studiengang, individuell erworbene Leistungspunkte und erzielte Noten
Einzelheiten zu den belegten Kursen und erzielten Noten sowie den Gegenständen der mündlichen und schriftlichen Prüfungen sind im „Zeugnis" enthalten.
Siehe auch Thema und Bewertung der Masterarbeit.

4.4 Notensystem und (wenn vorhanden) Notenspiegel
Allgemeines Notenschema (Abschnitt 8.6):
1,0 bis 1,5 = „sehr gut"
1,6 bis 2,5 = „gut"
2,6 bis 3,5 = „befriedigend"
3,6 bis 4,0 = „ausreichend"
Schlechter als 4,0 = „nicht bestanden"

1,0 ist die beste Note. Zum Bestehen der Prüfung ist mindestens die Note 4,0 erforderlich. Ist die Gesamtnote 1,1 oder besser wird das Prädikat „mit Auszeichnung" vergeben. ECTS-Note: Nach dem European Credit Transfer System (ECTS) ermittelte Note auf der Grundlage der Ergebnisse der Absolventinnen und Absolventen der zwei vergangenen Jahre: A (beste 10 %), B (nächste 25 %), C (nächste 30 %), D (nächste 25 %), E (nächste 10 %)

4.5 Gesamtnote (in Originalsprache)
beispielsweise: sehr gut (1,5)

4. INFORMATION ON THE PROGRAMME COMPLETED AND THE RESULTS OBTAINED

4.1 Mode of study
Full-time

4.2 Programme learning outcomes
The Master course "Solar System Physics" at the Technical University Braunschweig focuses on research and is marked by its distinct scientific orientation with a focus on solar system physics. The two-year-course leads graduates to a professional qualification as solar system physicists of highest international level. Hence, establishing the capability of autonomous work at the forefront of physical research in the field of solar system physics is our prime aim. The basis for this are both a further academic development and acquiring the essential strategic and practical competence typical for job description of a physicist, specialising in the physics of the solar system.
In the Master course the introduction into practical innovative work in science as well as the introduction into practical problem solving facing highly complex tasks in modern technology and business life is to be seen on an equal footing with a further scientific and academic development of knowledge.
A core element of the education in the Master course "Solar System Physics" is the research phase serving the development of autonomous scientific practice. After an introductory project into scientific practice, its central element is the Master thesis. In this phase scientific research is inextricably bound with the acquirement of key skills such as project management, team work and scientific communication.
The Master course qualifies particularly for autonomous research in the context of a dissertation in physics. Graduates of the Master course possess unique problem solving competences and employ these using their expert knowledge. Additionally, their interdisciplinary knowledge enables them to seize project leadership roles or chose a career in management in subsequent professional life.

4.3 Programme details, individual credits gained and grades/ marks obtained

See Certificate for list of courses and grades and for subjects assessed in final examinations (written and oral); and topic of thesis, including grading.

4.4 Grading system and (if available) grade distribution table
General grading scheme (Sec. 8.6):
1.0 to 1.5 = "excellent"
1.6 to 2.5 = "good"
2.6 to 3.5 = "satisfactory"
3.6 to 4.0 = "sufficient"
Inferior to 4.0 = "Non-sufficient"

1.0 is the highest grade, the minimum passing grade is 4.0.
In case the overall grade is 1.1 or better the degree is granted "with honors".
In the European Credit Transfer System (ECTS) the ECTS grade represents the percentage of successful students normally achieving the grade within the last two years: A (best 10 %), B (next 25 %), C (next 30 %), D (next 25 %), E (next 10 %)

4.5 Overall classification of the qualification (in original language)
e.g.: sehr gut (excellent) (1,5)

Diploma Supplement - Studiengangsspezifische Bestandteile

5. ANGABEN ZUR BERECHTIGUNG DER QUALIFIKATION
5.1 Zugang zu weiterführenden Studien
Berechtigung zur Promotion unter Berücksichtigung weiterer Zugangsvoraussetzungen.

5.2 Zugang zu reglementierten Berufen (sofern zutreffend)
Entfällt

6. WEITERE ANGABEN
6.1 Weitere Angaben
Entfällt

6.2 Weitere Informationsquellen
www.tu-braunschweig.de
www.tu-braunschweig.de/eitp

7. ZERTIFIZIERUNG DES DIPLOMA SUPPLEMENTS
Dieses Diploma Supplement nimmt Bezug auf folgende Original-Dokumente:
Urkunde über die Verleihung des Grades vom <<DatumUrkunde>> Prüfungszeugnis vom <<DatumZeugnis>>

5. INFORMATION ON THE FUNCTION OF THE QUALIFICATION
5.1 Access to further study
Access to PhD programmes in accordance in further admission regulations.

5.2 Access to a regulated Profession (if applicable)
Not applicable

6. ADDITIONAL INFORMATION
6.1 Additional Information
Not applicable

6.2 Further information sources
www.tu-braunschweig.de
www.tu-braunschweig.de/eitp

7. CERTIFICATION
This Diploma Supplement refers to the following original documents:
Document on the award of the academic degree (date) <<DatumUrkunde>>
Certificate (date) <<DatumZeugnis>>

Datum der Zertifizierung | Certification Date:

Offizieller Stempel | Siegel
Official Stamp | Seal

Prof. Dr.
Vorsitzende/Vorsitzender des Prüfungsausschusses |
Chairwoman/Chairman Examination Commitee

Technische Universität Braunschweig

Modules oft he Master’s Degree Programme

Solar System Physics
(MPO 2023)
Master

Annex 2

1. Specialised deepening phase

Module number	***Module***	
PHY-IGeP-30	Planetary Bodies *Qualifications aims:* The students - understand and are able to formulate the empirical and theoretical foundations of modern planetary science. - apply these fundamentals to planetary problems. - are able to independently select a suitable combination of methods for a given problem. - analyse the problems for this purpose and trace them back to empirical and theoretical foundations. *Examinations modalities:* (a) Study achievement: homework (b) Examination: oral examination (45min) or written examination (120min)	*CP:* 15 *Semester:* 1

Module number	***Module***	
PHY-IGeP-31	Solar System *Qualifications aims:* The students - understand and are able to formulate the empirical and theoretical foundations of modern solar and heliospheric physics as well as the formation and development of the solar system and can formulate them. - apply these fundamentals to astro-, heliophysical and planetological problems. - are able to independently select a suitable combination of methods for a given problem. - analyse the problems for this purpose and trace them back to empirical and theoretical foundations. *Examinations modalities:* (a) Study achievement: homework (b) Examination: oral examination (45min) or written examination (120min)	*CP:* 15 *Semester:* 1

Module number	***Module***	
PHY-IGeP-32	Hands-On Solar System Physics *Qualifications aims:* The students - can plan and apply the methods of numerical simulation, advanced data analysis procedures and space measurement techniques. - develop their own empirical solution methods for problems without a sound basis and justify them. - are able to analyse data using appropriate methods. - can plan, set up, carry out and evaluate simple laboratory experiments. - can derive conclusions for the relevant physical processes from the experiment results. - can analyse and interpret astronomical observations. - can analyse and evaluate their results in a comprehensible way in a protocol and a presentation. *Examinations modalities:* (a) Study achievement: Protocol and presentation on the Laboratory Solar System Physics internship (b) Study achievement: Protocol and presentation on the Astronomy internship (c) Study achievement: Protocol and presentation on the Data Analysis and Simulations internship	*CP:* 15 *Semester:* 2

Compulsory elective area Special Courses

Module number	**Module**	
PHY-IGeP-33	Computational Fluid Dynamics *Qualifications aims:* The students - understand the empirical and theoretical fundaments of fluid mechanics simulations and are able to formulate them. - apply these fundamentals to basic problems and issues in magnetohydrodynamics. - are able to independently select a suitable combination of methods for a given problem. - analyse the problems for this purpose and relate them back to empirical and theoretical foundations. *Examinations modalities:* (a) Study achievement: homework (b) Examination: oral examination (20min) or written examination (60min)	*CP:* 5 *Semester:* 1

Module number	**Module**	
PHY-IThPh-22	Space Plasma Physics *Qualifications aims:* - Acquisition of basic knowledge of plasma physics, the application of this knowledge to questions of extra-terrestrial plasmas and application of the acquired knowledge to phenomena in space - Computational, content-related and practical handling in the treatment of physical problems of space plasma physics. *Examinations modalities:* (a) Study achievement: homework (b) Examination: oral examination (20min) or written examination (60min)	*CP:* 5 *Semester:* 1

Module number	**Module**	
PHY-IGeP-34	Planetary Magnetospheres *Qualifications aims:* The students - understand the empirical and theoretical fundaments of plasma physics of planetary magnetospheres and are able to formulate them. - apply these fundamentals to problems in planetary magnetospheres. - are able to independently select a suitable combination of methods for a given problem. - analyse the problems for this purpose and relate them back to empirical and theoretical foundations. *Examinations modalities:* (a) Study achievement: homework (b) Examination: oral examination (20min) or written examination (60min)	*CP:* 5 *Semester:* 1

Module number	Module	
PHY-IGeP-35	Planetary Magnetism and Dynamo Theory *Qualifications aims:* The students - understand and are able to formulate the empirical and theoretical foundations of dynamo theory. - apply these fundamentals to dynamo models in the laboratory as well as to models in the context pf planetary bodies. - are able to independently select a suitable combination of methods for a given problem. - analyse the problems and trace them back to empirical and theoretical foundations. *Examinations modalities:* (a) Study achievement: homework (b) Examination: oral examination (20min) or written examination (60min)	*CP:* 5 *Semester:* 1

Module number	Module	
PHY-IGeP-36	Stellar Astrophysics *Qualifications aims:* The students - understand and are able to formulate the empirical and theoretical foundations of star formation, stellar structure and stellar evolution. - apply these fundamentals to specific problems. - are able to independently select a suitable combination of methods for a given problem. - analyse the problems and trace them back to empirical and theoretical foundations. *Examinations modalities:* (a) Study achievement: homework (b) Examination: oral examination (20min) or written examination (60min)	*CP:* 5 *Semester:* 1

Module number	Module	
PHY-IGeP-37	Extrasolar Planetary Systems *Qualifications aims:* The students - understand and are able to formulate the empirical and theoretical foundations of the discovery and structure of extrasolar planets and their systems. - apply these fundamentals to specific problems. - are able to independently select a suitable combination of methods for a given problem. - analyse the problems and trace them back to empirical and theoretical foundations. *Examinations modalities:* (a) Study achievement: homework (b) Examination: oral examination (20min) or written examination (60min)	*CP:* 5 *Semester:* 1

Module number	***Module***	
PHY-IGeP-38	Data and Signal Analysis *Qualifications aims:* The students - understand and are able to formulate the empirical and theoretical foundations of time-series analysis. - apply these fundamentals to problems of analysing measurement data. - are able to independently select a suitable combination of methods for a given problem. - analyse the problems and trace them back to empirical and theoretical foundations. *Examinations modalities:* (a) Study achievement: homework (b) Examination: oral examination (20min) or written examination (60min)	*CP:* 5 *Semester:* 1

Module number	***Module***	
PHY-IGeP-39	Geophysical Modeling *Qualifications aims:* *Electrical properties of geological materials* The students - understand and are able to formulate the empirical and theoretical fundamentals of electrical conduction and polarisation processes in heterogeneous materials. - apply these fundamentals to describe electrical properties of specific geological materials. - are able to select suitable modelling approaches for a given problem. - analyse the problems and trace them back to empirical and theoretical foundations. *Numerical simulatios in geophysics* The students - are able to plan numerical simulations and use them to solve geophysical problems. - know different strategies for optimising finite-element meshes and are able to use them. - are able to critically evaluate their simulation results. - are able to present their simulation results visually. - are able to document their approach and their results in a comprehensible way in a project report. *Examinations modalities:* (a) Study achievement: homework (b) Examination: Creation and Documentation of a Computer or Software Programme.	*CP:* 5 *Semester:* 1

Module number	***Module***	
PHY-IGeP-40	Comets and TNOs *Qualifications aims:* The students - can give an overview of the populations of TNOs and comets in the solar system and over past space missions to such objects. - understand basic physical processes occurring in comets and TNOs - can explain measurement methods relevant to cometary science and apply them in the approach - can describe physical models currently used in commentary research and apply them in the approach. *Examinations modalities:* (a) Study achievement: homework (b) Examination: oral examination (20min) or written examination (60min)	*CP:* 5 *Semester:* 1

Module number	Module	
PHY-IGeP-41	Asteroids *Qualifications aims:* The students - recognise the different classes of asteroids and meteorites - can describe the role of asteroids and meteorites in the wider context of the solar system - understand and can describe the most relevant measurement methods used in asteroid research - explain basic physical processing actin on asteroids *Examinations modalities:* (a) Study achievement: homework (b) Examination: oral examination (20min) or written examination (60min)	*CP:* 5 *Semester:* 1

Module number	Module	
PHY-IGeP-42	Space Technologies *Qualifications aims:* The students - understand the historical development of space technology since the 1960s and can correlate the benchmarks of this technical development with the discrete steps of increasing knowledge about the planets, moons, and small bodies of the solar system (which was gained mission by mission). - are able to specify, estimate, and substantiate the basic requirements of orbit mechanics for the accessibility of different destinations in the solar system (e.g. Hohmann trajectories, gravity-assist manoeuvers, flight durations, etc.). - are able to specify the basic requirements for the design of an interplanetary spacecraft which shall be bound for a given destination (e.g.: When is it inevitable to base on-board power generation on RPGs instead of solar arrays? Which subsystems will need multiple redundancy?). - are able to select a suited effective combination of different types of PI instruments for the scientific payload of an envisaged interplanetary science mission bound for a given destination. - can compare any envisioned future mission scenarios with historical missions that have already been successfully performed. *Examinations modalities:* (a) Study achievement: homework (b) Examination: oral examination (20min) or written examination (60min)	*CP:* 5 *Semester:* 1

Module number	***Module***	
PHY-IGeP-43	Space Missions and Project Management *Qualifications aims:* The students - understand how scientific space mission (in particular missions bound for destinations in the solar system) are structured in terms of project management, how their basic conception is - at first - being discussed within the scientific community, and how the projects are finally being selected and organized (in Europe mainly by ESA). - understand the role and responsibility of the Principal Investigators (PI's) during and after the "Announcement of Opportunity" (AO). - gain a thorough understanding of the importance of firm project phases with intermediate "Peer Reviews" and the corresponding management tools (RID's, NCR's, systematic project documentation, FMECA, risk analyses, "breadboard" and official qualification models, qualification and acceptance tests, etc.). - are enabled to define the organisation of a fictional project review (e.g. a PDR) for a hypothetically envisaged science mission: Which qualification levels and documentation standards would be required, what kind of experts should be asked for participation as "peers", which kind of RID's would be "major"? - are able to justify their proposals by examples and experiences from the real history of science missions in the solar system, as they will have been discussed in the preceding lectures. *Examinations modalities:* (a) Study achievement: homework (b) Examination: oral examination (20min) or written examination (60min)	*CP:* 5 *Semester:* 1

2. Research phase

Module number	***Module***	
PHY-IGeP-44	Scientific Key Qualifications *Qualifications aims:* The students - can solve numerical problems efficiently with the help of self-created programs. - can analyse extensive data sets with the help of self-created programs. - can visualise the results of their analyses and model calculations in an appealing way - can carry out scientific searches - can communicate specialised knowledge in writing. - can communicate specialised knowledge in the form of lectures. - can communicate in a team. *Examinations modalities:* (a) Study achievement: Creation and Documentation of a Computer or Software Programme (b) Examination: oral presentation	*CP:* 10 *Semester:* 2

Module number	***Module***	
PHY-IGeP-45	Literature Research *Qualifications aims:* The students - are able to assess the state of the art in a field of solar system research. - can read scientific papers in a goal-oriented manner and reproduce the essential contents in their own words. - are able to structure and organise their own research work. - are able to present the results of their own work to an expert audience in written and oral form in a professional manner. *Examinations modalities:* Study achievement: oral presentation	*CP:* 5 *Semester:* 1

Module number	***Module***	
PHY-IGeP-46	Research Internship *Qualifications aims:* The students acquire experimental and theoretical skills to carry out research. In close contact with the chosen research group, the students lay the technical and experimental foundations for their future master projects. They acquire the skills to independently carry out experiments or theoretical investigations that are relevant for the thesis project. They acquire the skills to professionally present their own work and results in a scientific context. *Examinations modalities:* (a) Study achievement: successful execution of the research internship (b) Examination: oral presentation on the contents and objectives of the Master's thesis	*CP:* 15 *Semester:* 2

Module number	***Module***	
PHY-IGeP-47	Master Thesis *Qualifications aims:* The students are able to work on a topic in the field of solar system physics under guidance using scientific methods within a given time limit. In doing so, they show that they understand technical correlations and can expand scientific knowledge boundaries. They can present and assess the procedure and results in the form of a paper. The students can organise their own scientific project. *Examinations modalities:* Examination: Master Thesis	*CP:* 30 *Semester:* 2