Technische Universität Berlin

Module and Course Description

Intake 2017

as of October 1, 2017

Master of Science

in

Global Production Engineering

How to enroll for modules/courses

1. Enrollment

Enrollment for all courses in the GPE-online-system is mandatory each semester!

During the lecture a participation list must be signed. If your name is not on that list, you have not enrolled properly. This means you must enroll for the class before the next lesson.

Our online system offers the opportunity to choose between "for credits" or "for proof of attendance".

For "credits" means:
The course will appear on your transcript and its grade will be a part of your final average grade on your master degree certificate.

For "proof of attendance" means:
Only "lectures (VL)" are available for participation only. You can attend in lectures, but you cannot actively participate in class, group work, test, exams etc.
All other course types e.g. "exercises (UE)", "seminars (SE)" or "projects (PJ)" are not offered for "participation only" or "proof of attendance".

*Courses you have chosen to take for participation only **cannot afterwards** be transferred to a "credit" course.*

2. Statement of Enrollment

You will receive an email informing you about the modules/courses you are enrolled during week 46.

You are then required to confirm by return email until November 19, 2017 your statement about the modules/courses you have enrolled for as follows:

3. Pre-Registration

Ref: Name, First name, Matr-no., Intake 2017 – Registration WS 2017/2018

The following courses I wish to

1. Cancel

- Course 1, name
- Course 2, name

2. Take for participation only*

- Course 1, name
- Course 2, name

3. Take for credits

- Course 1, name
- Course 2, name

This email is the basis for your final registration. Deadline: November 19, 2017 at 24:00

4. Final Registration

***In week 47, which is the week November 20 – November 24 you must register your credit modules** by signing these modules personally at the GPE Student Office.*
Special Opening hours will be confirmed in due time.

A Module Group Production

Module Title:	**CP (ECTS):**	**Acronym:**	**Module Group:**
Manufacturing and Factory Planning	12	MFP17	Production
Responsible for Module:	**Secretary:**	**E - mail:**	
Prof. Dr.-Ing. Günther Seliger	GPE	seliger@mf.tu-berlin.de	

Module Description

1. Qualification Goals

In the educational curriculum and practices, the students are acquainted with the basics of production and workshop planning, including the elementary knowledge on types of factories, further evaluation of technology, system theories, planning and controlling strategies of factories. Students gain state of the art knowledge about value creation, factory elements and operations management. One focus is layed on production planning and control. Through case studies, the theoretically thought contents can be deepened in extracts.

The module imparts predominantly the following competence:

Technical 30%	Methodical 30%	Systemic 20%	Social 20%

2. Contents

Manufacturing and Factory Planning

Manufacturing as integral part of technological, logistical, economical, and ecological process chains; manufacturing processes and facilities; manufacturing scheduling; simultaneous engineering; project management; layout and material flow; human labour and qualification; application potentials for information and communication technological tools; methods and paths of innovation; object and phase oriented task management and leadership; models of business integration and networking:

The course is separated into lectures and seminars on selected topics of manufacturing and factory planing

- Concepts and definition of factory work
- Factory types
- Culture, man and automation
- Work and technique
- Project management
- Portfolio concepts
- Calculation of process costs
- Product and process innovation
- System theory
- Sustainable Manufacturing
- Energy Management
- Availability
- Simulation of production systems
- Factory planning
- Layout planning
- Production network planning
- Planning of operation facilities
- Planning of buildings and elements of industrial buildings
- Launching of operations
- Conceptions of factory control
- Remanufacturing
- ICT in Manufacturingthe reutilization equipment if applicable

Manufacturing and Factory Planning
Case Studies Part one and two

- The main goal of the two-semester course is to strengthen the entrepreneurial thinking of students. The three levels of sustainability are addressed. Teams are built in order to plan the manufacturing site and production methods of a factory set to the fabrication of a determined product family. Throughout an iterative process, the designed layouts and schemes are then improved by means of the lecture's content. The teams' results are to be presented and documented. Each group is assigned with different research topics and factory conditions.
- In a first step, research about factory planning techniques and strategies is done by students and presented in plenum.
- In a second step, students select and analyze an already existing plant and visualize the material flow. A similar plant shall be opened at a new location in another country. The site selection is performed by the groups.
- In a third step, the processes for the new plant have to be improved. Therefore, a Failure Mode and Effects analysis (FMEA) of the manufacturing process and an Overall Equipment Effectiveness (OEE) have to be worked out for the already existing plant. Three possible scenarios for the new location are presented and the best is chosen.
- In a fourth step, the material flow diagram for the new plant gets augmented with emissions, wastes and other by-products. The use of reutilization equipment is evaluated for the new plant. The chosen material flow diagram has to be improved including the reutilization equipment if applicable.

Module Title:	**CP (ECTS):**	**Acronym:**	**Module Group:**
Manufacturing and Factory Planning	12	MFP17	Production

Learning Factory

The course takes place in the Learn Factory of a globally known pharmaceutical producer. The course includes the following topics:

- Methods and practices of lean management, logistics and quality management
- Performance Management
- Key Performance Indicators
- Change Management

A holistic approach towards the conveyance of knowledge and skills is performed in a learning-by-doing schema. Teaching methods include literature reading, text analysis, individual presentation, (academic) writing project work, and the physical implementation in a real manufacturing environment of concepts learned throughout the module.

Manufacturing and Factory Planning Operations

- Layout planning
- Product and Process planning and development
- Manufacturing planning and strategies
- Manufacturing and Assembly techniques
- Division of labor
- Factory Management
- Closed loop cycles within manufacturing processes

Manufacturing of Wind Turbine Components

- Introduction to the technical Utilization of Wind Power
- Overview to Wind Turbine components and their main functions
- Manufacturing of WT – design process, manufacturing of components and subassemblies,
- Quality Management (QM) and logistic of Manufacturing, transportation and erecting of WT
- Main component WT Rotor 1: Rotor Blades, Main component WT Rotor 2: Rotor Hub, Pitch System
- Drive Train 1: Bearing, shafts, Couplings
- Drive Train 2: Main Gear box and Generator types
- Main Frame and Nacelle assembling
- WT Towers
- Foundation and grid connection (cabling, transformer, substation)
- Transport (oversea and local), handling, transportation vessels cranes
- Erecting WT and initial operation (commissioning)
- Legal and permissions, insurances

Fields of Application for Solar Thermal Systems

- Basics of Solar Thermal technologies: functionality, required conditions, efficiencies, characterization.
- Motivation, potential und market development for Solar Thermal Systems
- Kinds of solar thermal Collectors with temperature ranges, basics radiation and physics for collectors
- Basics of power generation
- Applications in the residential sector: Space/water heating and cooling, cooking, drying, etc.
- Industrial applications - Process Heat Desalination, drying, preheating, etc.
- Solar assisted heat networks: Local and district heating.
- Energy storage possibilities

3. Literature and Script

Literature, as announced in lectures according to respective subjects.

- Seliger, G. (Editor), *Sustainability in Manufacturing - Recovery of Resources in Product and Material Cycles*, Springer Verlag, Berlin, Heidelberg 2007.
- Seliger, G., Nasr, N., Bras, B., Alting, A. (Editors), *Proceedings Global Conference on Sustainable Development and Life Cycle Engineering*, uni - edition, Berlin 2004.
- Silver, E., Pike, D., and Peterson, R., *Inventory Management and Production Planning and Scheduling*, Wiley, 1998.

So far, there is only a small number of printed publications available, specializing in manufacturing of solar components. The following list aims at providing some access points to relevant literature or other resources.

Module Title:	CP (ECTS):	Acronym:	Module Group:
Manufacturing and Factory Planning	12	MFP17	Production

Photovoltaics:
European PV Technology Platform, http://www.eupvplatform.org/
Journal: Photovoltaics international (Semiconductor Media, part of Henley Media Group), www.pv-tech.org
Industry association: http://www.vdma.org; choose 'VDMA Branchen', then 'Photovoltaik Produktionsmittel'
Very comprehensive annuary of companies offering PV production technology and solutions: Engineering the solar age, http://www.pv-zulieferer.de/index.php?id=69&L=1

Solar thermal:
European Solar Thermal Technology Platform, http://esttp.org/cms/front_content.php

Wind Turbine
Gasch/Twele: Wind Power Plants

4. Module Courses

Course Title	Type [1]	SWH [2]	CP [3]	P/W/WP [4]	WS/SS
Manufacturing and Factory Planning	IV	2	3	P	WS
Manufacturing and Factory Planning Case Studies Part one	PJ	2	3	WP	WS
Manufacturing and Factory Planning Case Studies Part two	PJ	2	3	WP	SS
Learning Factory	UE	2	3	WP	WS
Fields of Application for Solar Thermal Systems	VL	2	3	WP	WS
Manufacturing and Factory Planning Operations	UE	4	6	WP	WS
Manufacturing of Wind Turbine Components	IV	2	3	WP	WS

Course Title	Docent/Lecturer	Language
Manufacturing and Factory Planning	Prof. Dr.-Ing Günther Seliger	English
Manufacturing and Factory Planning Case Studies Part one	Jan Philipp Menn, M.Sc.	English
Manufacturing and Factory Planning Case Studies Part two	Jan Philipp Menn, M.Sc.	English
Learning Factory	Felix Sieckmann, M.Sc.	English
Fields of Application for Solar Thermal Systems	Prof. Dr.-Ing. habil. R. Hanitsch	English
Manufacturing and Factory Planning Operations	Dr.-Ing. Palacios Neffke	English
Manufacturing of Wind Turbine Components	Dipl.-Ing. Jan Liersch/Dipl.Ing. S.Wiens	English

5. Description of Teaching Mode

Manufacturing and Factory Planning, Manufacturing and Factory Planning Case Studies Part one and two, Learning Factory
Contents are presented in lectures illustrated by case studies. In exercises students' abilities are trained by solving technological business case oriented tasks establishing problem solving capabilities. Seminars for special task groups enable for problem solving in teamwork and cooperation. Challenging tasks for a respective master thesis are continuously provided in cooperation with industrial development partners.

Fields of Application for Solar Thermal Systems
Content are presented in lectures illustrated by case studies. Practical exercises and experiments are considered as part of the lecture.

Manufacturing and Factory Planning Operations EX
Intensive workshops are conducted. Student teams are to design own process layouts and production strategies to manufacture exemplary products.

Manufacturing of wind turbines components
Content is presented in lectures illustrated by case studies and exercises with calculations and examples. In exercises students' abilities are trained by solving technological business case oriented tasks establishing problem solving capabilities.

Module Title:	CP (ECTS):	Acronym:	Module Group:
Manufacturing and Factory Planning	12	MFP17	Production

6. Condition for Participation

Mandatory: None
Preferable: None
Specials:
Participation in "MFP Case Studies Part one" requires also participation in "MFP Case Studies Part two" and vice versa.

7. Teaching and learning activities (Effort and Credit Points)

Manufacturing and Factory Planning:
25 hours contact, 20 hours post-processing and homework, 10 hours reading, 15 hours preparation for course, 20 hours preparation for examination
Manufacturing and Factory Planning Case Studies:
30 hours contact, 30 hours preparation for course, 10 hours post-processing, 70 hours reading and preparation for documentation, 40 hours project work.
Learning Factory:
30 hours contact, 20 hours preparation for course, 10 hours reading, 30 hours preparation for examination and homework and documentation.
Total: 360 hours = 12 CP (30 hours = 1 CP).
Fields of Application for Solar Thermal Systems
30 hours contact, 30 hours preparation for course, 10 hours post-processing, 70 hours reading and preparation for documentation, 40 hours project work.
Manufacturing and Factory Planning Operations EX
60 hours contact, 30 hours preparation for course, 10 hours post-processing, 70 hours reading and preparation for documentation, 40 hours project work.
Manufacturing of Wind Turbine Components
30 hours contact, 30 hours preparation for course, 10 hours post-processing, 70 hours reading and preparation for documentation, 40 hours project work.

8. Assessment criteria (Examination and Grades)

Examination:
Portfolio examination according to examination regulations, Section 12.

Prerequisites for admission to written examination of MFP:
Manufacturing and Factory Planning
none
Manufacturing and Factory Planning Case Studies Part one
Passing MFP-IV Test
Learn Factory
Passing MFP-IV Exam
Fields of Application for Solar Thermal Systems
Passing MFP-IV Exam
Manufacturing and Factory Planning Operations EX
Passing MFP-IV Test
Manufacturing of Wind Turbine Components
Passing MFP-IV Test

Grading:
Each course is weighted according to the respective credits.
Manufacturing and Factory Planning – 25% of module grade
written test (60 min.)
Manufacturing and Factory Planning Case Studies Part one and two – each Part
25% of module grade

Module Title:	CP (ECTS):	Acronym:	Module Group:
Manufacturing and Factory Planning	12	MFP17	Production

interim presentation (5 min. / student): 25%, final presentation (5 min. / student): 30%, final report: 45%, thereof 30% for the overall assessment and 15% through individual contributions
Learn Factory – 25% of module grade
written report in small groups
Fields of Application for Solar Thermal Systems – 25% of module grade
written test
Manufacturing and Factory Planning Operations EX – 50% of module grade
presentation 1: 15%, presentation 2: 15%, presentation 3: 20%, written test: 50%
Manufacturing of Wind Turbine Components – 25% of module grade
Multiple choice test (15 questions) – 30%
Abstract and short presentation (max. 8 slides) individual: 70%

9. Duration of Module

The module can be performed within one semester.

10. Number of Participants[5]

Lectures are unlimited. Exercises are limited to 30 participants.

11. Inscription Formalities

Registration at the GPE-Student office according to the GPE study and examination regulations.
Dates and deadlines will be announced by semester start. Exercise groups will be determined in the first lecture.

Module Title:	**CP (ECTS):**	**Acronym:**	**Module Group:**
Production Technology	12	PT	Production
Responsible for Module:	**Secretary:**	**E - mail:**	
Prof. Dr.-Ing Eckart Uhlmann	PTZ 1	uhlmann@iwf.tu-berlin.de	

Module Description

1. Qualification Goals

In order to meet the challenges of the permanently changing international markets, it is necessary to be aware not only of the global connections but also of the relations within the factory as well as of the interactions with its environment. The factory science and its special branches provide the necessary conditions in this respect. The development of modern, innovative factory structures is not a pure result of the technical progress, it is rather the outcome of combining the results of production-, economical- and sociological sciences with the experience in the operational practice.

Within the scope of the lectures and experiment-related exercises of the section Production Technology the students get a system-oriented picture of the factory, with the aim of elaborating the connections among which a factory is operated. Conventional types of factories as well as new conceptions of their further development will be examined. Another point of emphasis is the explanation of fundamental production technologies and the corresponding means of production. Great importance will be attached to the analysis of the structure of these technologies and to their correlation. The experiment-related exercises complete the lectures by in-depth treating the topics and practical exercises. The exercises belonging to the courses Production technology I and II will be carried out in a series of joint training within one semester. In this module students gain competencies in selection, planning and application of production processes.

The module imparts predominantly the following competence:

Technical 40%	Methodical 40%	Systemic 10%	Social 10%

2. Contents

The factory business forms the framework of the lecture Production Technology. Within the lecture, the issues of technological as well as management questions are addressed. Among the contents there are lectures of manufacturing processes for the manufacturing of industrial goods on the one hand and the teaching of basics of production and factory planning, product planning, work planning, quality management and technology management on the other hand. Besides the acquiring of expert knowledge, the student will get the ability of systematical problem solving.

The exercise consists of 10 single exercises: Fundamentals of cutting technology, fundamentals of numerical control, abrasive machining, non - conventional machining, dynamical behavior, thermal behavior, robot technology, industrial disassembly, safety engineering und Rapid Prototyping.

Production Technology I and Exercise (6 SWH)

- System factory management
- Product planning
- Production planning
- Material technology
- Manufacturing technology
- Technology: castings
- Technology: sintered parts
- Technology: massive parts
- Technology: sheet Metal parts
- Technology: rotational parts
- Technology: prismatic parts
- Technology: precision parts
- Technology: non - conventional machining

Production Technology II (2 SWH)

- Technology: joining
- Information systems
- Organisation
- Personnel.
- Business planning and modelling
- Process planning
- CAM / WOP technique
- Controlling
- Quality / quality management
- Technology management

3. Literature and Script

Literature, as announced in lectures according to respective subjects:

- J. M. Usher, Uptal Roy, Parsaei, *Integrated Product and Process Development*, 1998.
- Chase, Aquilano, Jacobs, *Production and Operation Management*, 1999.
- Eversheim, W., *Organisation in der Produktionstechnik*, Düsseldorf, VDI - Verlag, 1996.
- Spur, G., Krause, F. - L., *Das virtuelle Produkt*, München, Wien, Hanser Verlag, 1997.

Module Title: *Production Technology*	**CP (ECTS):** 12	**Acronym:** PT	**Module Group**: Production

- Wiendahl, H. - P., *Betriebsorganisation für Ingenieure*, München, Wien, Hanser Verlag, 1989.

Printed and/or electronic scripts as announced in lectures.

4. Module Courses

Course Title	Type	SWH	CP	P/W/WP	WS/SS
Production Technology I	VL	2	3	P	WS
Exercise in the Test Field for Machine Tools and Manufacturing Technology Group 1	UE	4	6	P	WS
Production Technology II	VL	2	3	P	SS
Exercise in the Test Field for Machine Tools and Manufacturing Technology Group 2	UE	4	6	P	SS

Course Title	Docent/Lecturer	Language
Production Technology I	Prof. Dr.-Ing Eckart Uhlmann	English
Exercise in the Test Field for Machine Tools and Manufacturing Technology Group 1	Dr.-Ing. Jörg Bold/ Robert Bolz, Dipl.-Ing.	English
Production Technology II	Prof. Dr.-Ing Eckart Uhlmann	English
Exercise in the Test Field for Machine Tools and Manufacturing Technology Group 2	Dr.-Ing. Jörg Bold/ Robert Bolz, Dipl.-Ing.	English

5. Description of Teaching Mode

Contents are presented in lectures illustrated by case studies. In the beginning of the exercises the theoretical fundamentals and most important facts and data related to the respective topic are presented. Subsequently, detailed explanations about these topics follow at the machines and test stands in the test field of the PTZ.

6. Condition for Participation

Mandatory: None
Preferable: None

7. Teaching and learning activities (Effort and Credit Points)

Lectures: 60 hours contact, 45 hours post-processing and homework, 45 hours reading, 30 hours preparation for examination
Exercises: 60 hours contact, 45 hours preparation, 45 hours documentation, 30 hours preparation for examination
Total: 360 hours = 12 CP (30 hours = 1CP).

8. Assessment criteria (Examination and Grades)

Examination:
Written examination according to examination regulations, Section 11.
Prerequisites for admission to oral/written examination:
Passing all exercises.
Grading:
100% written examination.

9. Duration of Module

The module is performed within two semesters.

10. Number of Participants

Group 2 will only be offered upon request and depends on the number of students applied for the course. Lectures are unlimited, exercises are limited up to 20 participants.

Module Title: *Production Technology*	**CP (ECTS):** 12	**Acronym:** PT	**Module Group**: Production
11. Inscription Formalities			
Registration at the GPE-Student office according to the GPE study and examination regulations. Dates and deadlines will be announced by semester start. Exercise groups will be determined in the first lecture.			

Module Title: *Additive Manufacturing*	**CP (ECTS):** 6	**Acronym:** AM	**Module Group**: Production
Responsible for Module: Prof. Dr.-Ing. Günther Seliger	**Secretary:** GPE	**E - mail:** seliger@mf.tu-berlin.de	

Module Description

1. Qualification Goals

The AM teaching module gives an overview about the technology of additive manufacturing, provides knowledge about the design for additive manufacturing, necessary digital tools, materials and fields of application. Students will be prepared for a systematic understanding of this technology regarding production technological matters that consider planning, manufacturing, control and services. By applying the contents of the lecture and the exercise, the students are prepared for the self-depended application of planning and manufacturing tasks for this technology.

The module imparts predominantly the following competence:

Technical 25%	Methodical 40%	Systemic 25%	Social 10%

2. Contents

Technology overview; industrial application; prosumer application; advantages; sustainability potentials; AM services; process chain; digital tools for AM: Computer Aided Design (CAD), mesh repair, file converter, slicer; design for additive manufacturing; VDI 3405; thermal behavior; materials for AM; AM-technologies: Fused Deposition Modelling (FDM): printer layouts, elements and structure, setting up the printer, materials overview and properties, recycling of materials, troubleshooting; Selective Laser Sintering (SLS); Laminated Object Manufacturing (LOM), Selective Laser Sintering (SLS), Electron Beam Melting (EBM), Multijet Modeling (MJM), Stereo Lithography (SLA); Open Source; communities; MakerSpaces; future perspective and outlook; hands-on-experience: group work, 3D printing challenge.

3. Literature and Script

Electronic scripts as announced in lectures.
Literature:

- Gebhardt, A., & Hötter, J. (2016). Additive manufacturing: 3D printing for prototyping and manufacturing.
- Gibson, I., Rosen, D., & Stucker, B. (2010). Additive manufacturing technologies: Rapid prototyping to direct digital manufacturing. Berlin: Springer.
- Anderson, C., & Schmid, S. (2013). Makers: The new industrial revolution. Crown Business.

Details to further additional readings will be given in the courses.

4. Module Courses

Course Title	Type	SWH	CP	P/W/WP	WS/SS
Additive Manufacturing Lecture	VL	2	3	P	WS
Additive Manufacturing Project Group 1	UE	2	3	P	WS
Additive Manufacturing Project Group 2	UE	2	3	P	WS

Course Title	Docent/Lecturer	Language
Additive Manufacturing Lecture	Dipl.-Ing. Bernd Muschard	English
Additive Manufacturing Project Group 1	Dipl.-Ing. Bernd Muschard	English
Additive Manufacturing Project Group 2	Dipl.-Ing. Bernd Muschard	English

5. Description of Teaching Mode

The modules consist of the lecture Additive Manufacturing (VL) and the supplementary and exemplifying exercises Additive Manufacturing Project (UE).

Explorative, situational and problem-oriented teaching methods will be used to provide knowledge and skills about additive manufacturing. Technical as well as methodical contents will be taught. In order to successfully pass the module, it is necessary to participate in the lecture (VL) and the exercise (UE).

In practical exercises students are motivated to hands-on experience with 3D printers of the technologies Fused Deposition Modeling (FDM) and Selective Laser Sintering (SLS) on given projects, mostly in teamwork. The focus is laid on the application of Additive Manufacturing for prototyping and for small projects.

Module Title: *Additive Manufacturing*	**CP (ECTS):** 6	**Acronym:** AM	**Module Group**: Production

6. Condition for Participation

Mandatory: -
Preferable: Participation in “Production Technology” and/or “Manufacturing and Factory Planning”

7. Teaching and learning activities (Effort and Credit Points)

Contact hours: Lecture: 30 h, practical exercises: 30 h, Course preparation and post-processing: 90 h,
Exam preparation: 30 h
Total: 180 hours = 6 CP (30 hours = 1 CP).

8. Assessment criteria (Examination and Grades)

Examination[6]:
Portfolio Examination according to examination regulations, Section 12.
Prerequisites for admission to written test:
80% participation in lectures and exercises
Grading:
Additive Manufacturing Lecture
50% written test (70 min.)
Additive Manufacturing Project
20% presentation, 30% practical exercises

9. Duration of Module

The module can be completed within one semester.

10. Number of Participants

Group 2 will only be offered upon request and depends on the number of students applied for the course.
Lecture is limited to 30 participants; exercises are limited to 15 participants each.

11. Inscription Formalities

Registration at the GPE-Student office according to the GPE study and examination regulations.
Dates and deadlines for lecture, practical experience and exam will be announced at the beginning of each semester.

B Module Group Engineering

Module Title: *Engineering Design and CAD Modeling*	**CP (ECTS):** 12	**Acronym:** EDCAD	**Major field:** Engineering
Responsible for Module: Prof. Dr.-Ing. Rainer Stark	**Secretary:**	**E - mail:** rainer.stark@tu-berlin.de	

Module Description

1. Qualification Goals

Students know common machine elements and design rules in engineering. They are able to draft individual solutions according to ISO drawing standards and understand production drawings including dimensions and tolerances. Rules of drawing, design principles and guidelines can be applied to technical drafts.

Students have a basic insight into working with modern engineering design systems with main focus on CAD, in particular into direct and parametric modelling systems. They are prepared for modern collaboration practice in product development processes, utilizing a state of the art Product Management System (PDM). Engineering students are provided with knowledge, methods and tools for the process of virtually creating and validating a product.

The module imparts predominantly the following competence:

Technical 35%	Methodical 35%	Systemic 20%	Social 10%

2. Contents

Engineering Design:

Fundamentals of Engineering Design: function, layout, design, manufacture, and assembly; fundamentals of machine elements: use and function; durability of machine elements: load, stress, strain and failure prediction for static loading; conceptual and embodiment design. Design and draft of a mechanical product.

CAD Modeling:

The course covers essential topics of Computer Aided Design (CAD) and Product Development using mainly Siemens PLM NX from basics such as part design by sketch based feature modeling, enriching parts and drawings by Product and Manufacturing Information (PMI), creating assemblies using design-in-context and giving introduction to basic validation technologies up to simple finite element analysis (FEA) and kinematics studies. It is accompanied by hands-on-classes on a product data management (PDM) system such as Siemens PLM Teamcenter.

3. Literature and Script

Books:

- Pahl, G., Beitz, W., *Engineering Design – A Systematic Approach*, 3rd ed, London, New York, Springer, 2007.
- K. Ulrich & S. Eppinger: Product Design and Development. 5th Ed., Boston, 2011
- C. Hales & S. Gooch: Managing Engineering Design. 2nd Ed., London, 2004
- Dubbel, *Handbook of Mechanical Engineering*, London, New York, Springer, 1994.
- Norton, Robert L., Machine Design - An Integrated Approach, Pearson Educ, 2013.
- Shigley Joseph E, Mischke, Charles R., *Mechanical Engineering Design*. 6. Ed. Boston, McGraw Hill International Edition, 2001.
- Hamrock, Bernard J. et. al., *Fundamentals of Machine Elements*, Boston, WCB McGraw - Hill (www.mhhe.com) 1999.

Printed and/or electronic scripts as announced in lectures.

4. Module Courses

Course Title	Type	SWH	CP	P/W/WP	WS/SS
Engineering Design	IV	4	6	P	WS and SS
CAD Modeling	IV	4	6	P	WS and SS

Course Title	Docent/Lecturer	Language
Engineering Design	Sebastian Werner M.Sc / Cornelia Muessig M.Sc.	English
CAD Modeling	Dipl.-Ing. T. Vorsatz	English

Module Title: *Engineering Design and CAD Modeling*	**CP (ECTS):** 12	**Acronym:** EDCAD	**Major field**: Engineering

5. Description of Teaching Mode

Engineering Design:
Integrated lecture and exercises; project work
CAD Modeling:
Lectures and exercises, homework assignments

6. Condition for Participation

Mandatory: Fundamental knowledge in technical mechanics
Preferable: Systematic Product Development, basic knowledge of machine elements and product development projects

7. Teaching and learning activities (Effort and Credit Points)

ED: 30 hours lecture, 30 hours exercise, 30 hours post–processing; 90h work on assignment
CAD: 60 hours lectures/exercises (integrated); 60 hours post-processing / preparation, 60 hours work on assignments

8. Assessment criteria (Examination and Grades)

Examination:
Portfolio Examination according to examination regulations, Section 12.
Grading:
Engineering Design:
50% of module grade
Practical test comprising calculation and technical drawing 25%; assignment to be submitted during 2nd semester 25%
CAD Modeling:
50% of module grade
3-5 assignments during semester (varying tasks)

9. Duration of Module

The module can be performed within two semesters.

10. Number of Participants

The number of participants is limited to max. 32 participants.

11. Inscription Formalities

Registration at the GPE Student Office may occur prior to the Registration Week. Dates and Deadlines will be announced by semester start.

Attendance in the first lectures for both CAD and ED is strongly recommended. Allotment of seats on the basis first come first served. The lecturers reserve the right to refuse participants who missed the first lecture.

Module Title: *Systematic Product Development*	**CP (ECTS):** 6	**Acronym:** SPD17	**Major field:** Engineering
Responsible for Module: Prof. Dr.-Ing. D. Göhlich	**Secretary:** H10	**E - mail:** tu-anh.fay@tu-berlin.de	

Module Description

1. Qualification Goals

Product Development is a key to success in the customer – manufacturer - customer chain. The objective of the lecture is to provide knowledge and skills for the use of methods in the early stages of the design process. The knowledge, understanding and use of these methods enable a continuous systematic product development. By empowering the students to recognize different methodological approaches and industrial procedures, a broad understanding and a holistic view of the product development process is taught.

The module imparts predominantly the following competence:

Technical 35%	Methodical 35%	Systemic 20%	Social 10%

2. Contents

The choice of topics is determined by the phases of the product development process and subsequent the life - cycle phases. Emphasis is being given to topics based on practical experience and research activities. The examples are drawn from all areas of mechanical engineering. Systematic Product Development is based upon experiences with the design problems and practical solutions and strives for a view that is applicable to all areas of the production process, focusing on common problems and their solutions. In particular, the following topics will be discussed.

- Introduction to SPD
- Product Planning
- Task Clarification & Problem Statement
- Interrelationships in Technical Systems
- Solution Finding Methods
- Selection & Evaluation Methods
- Basic Rules of Embodiment Design
- Developing Modular Products

During the semester, groups of students will work on a product development project, applying the methods taught in the course.

3. Literature and Script

Books:

- Pahl, G., Beitz, W., *Engineering Design – A Systematic Approach*, 3rd ed, London, New York, Springer, 2007.
- K. Ulrich & S. Eppinger: Product Design and Development. 5th Ed., Boston, 2011
- C. Hales & S. Gooch: Managing Engineering Design. 2nd Ed., London, 2004
- Dubbel, *Handbook of Mechanical Engineering*, London, New York, Springer, 1994.
- Norton, Robert L., Machine Design - An Integrated Approach, Pearson Educ, 2013.
- Shigley Joseph E, Mischke, Charles R., *Mechanical Engineering Design*. 6. Ed. Boston, McGraw Hill International Edition, 2001.
- Hamrock, Bernard J. et. al., *Fundamentals of Machine Elements*, Boston, WCB McGraw - Hill (www.mhhe.com) 1999.

Printed and/or electronic scripts as announced in lectures.

4. Module Courses

Course Title	Type	SWH	CP	P/W/WP	WS/SS
Systematic Product Development IV	IV	4	6	P	SS

Course Title	Docent/Lecturer	Language
Systematic Product Development IV	Tu-Anh Fay, M.Sc.	English

5. Description of Teaching Mode

Integrated lecture with concrete examples to be worked on in groups.

6. Condition for Participation

Mandatory: Fundamental knowledge in engineering mechanics
Preferable: Basic knowledge of machine elements, Basic knowledge of engineering design

Module Title: *Systematic Product Development*	**CP (ECTS):** 6	**Acronym:** SPD17	**Major field**: Engineering

7. Teaching and learning activities (Effort and Credit Points)

60 hours contact, 30 hours preparation and post – processing of lecture, 60 hours work on semester project, 30 hours preparation for examination

8. Assessment criteria (Examination and Grades)

Examination:
Portfolio Examination according to examination regulations, Section 12.
Grading:
Oral exam (20 min.) = 50%
project presentation = 20% in group work
project documentation = 30% in group work

9. Duration of Module

The module can be performed within one semesters.

10. Number of Participants

The number of participants is limited to max. 30 participants.

11. Inscription Formalities

Registration at the GPE-Student office according to the GPE study and examination regulations.
Dates and deadlines will be announced by semester start.

Module Title:	**CP (ECTS):**	**Acronym:**	**Module Group:**
Renewable Power Technologies	6	RPTG17	Engineering
Responsible for Module:	**Secretary:**	**E - mail:**	
Dr. Emilienne Tingwey	RENAC	zaehringer@renac.de	

Module Description

1. Qualification Goals

In this module students will get a comprehensive overview of the main, commercially-viable and upcoming renewable power technologies, and come to understand how they work and how systems are designed.
Further on, the incorporation of renewable power capacity into electricity grids is a crucial issue for a successful development of the renewable power sector and will thus be discussed thoroughly.
This module is targeted towards students who wish to broaden their perspective and gain basic knowledge to understand the challenges of re-shaping power supply towards a higher share of renewable power generation.
The qualification goals of this module are:

- Understanding renewable power technologies
  - Technology-specific renewable resources and their potential
  - Working principles, initial system design
  - Power supply characteristics
  - Quantifying power and energy yield
  - Status quo of the technologies and potential
  - Investment and operation costs
- Enable students to assess requirements to incorporate large shares of variable renewable power capacities PV and wind into the power supply system
  - Short term wind and PV power forecast and market operation
  - Firm capacity of wind and PV - capacity credit calculation
  - Balancing power calculation for variable renewable energy wind and PV

Develop a fundamental understanding of the interaction of different renewable power sources in an energy supply system.

The module imparts predominantly the following competence:

Technical 50%	Methodical 20%	Systematical 20%	Social 10%

2. Contents

- Wind energy (14h) with practical exercises
  - Calculation of annual energy production of wind turbines and wind farms
  - Wind resources
  - Wind power technology, wind turbine generator types, wind blower calibration
  - Power curve measurements
- Bioenergy (11h)
  - Biogas technology, utilization of biogas
  - Biomass combustion, biomass gasification
  - Biomass Case Study Exercise
- PV off-grid and hybrid (8h) with practical exercises
  - Applications and configurations
  - Categorization of PV – diesel hybrid systems; coupled system projects
- Integration of renewables into the power sector (12h) with practical exercises
  - Residual load calculation
  - Long Term Time Series for Scenarios of Wind and Photovoltaic Power
  - Short-term Power Generation
  - Probabilistic Balancing Power Calculation
- Economic optimization of energy supply systems (11h) with practical exercises
  - Introduction to the concept of Levelized Costs of Electricity (LCOE)
  - Method to determine the LCOE
  - Planning of a cost optimized electricity supply system considering variable electricity demand
- Field trip to wind and solar farm and biogas power plant (8h)
  - Visit of an energy self-sufficient village: solar PV, bioenergy, windfarm

Module Title:	**CP (ECTS):**	**Acronym:**	**Module Group:**
Renewable Power Technologies	6	RPTG17	Engineering

3. Literature and Script

Fundamentals / General interest
Recommended, printed and/or electronic scripts as announced in the lectures.

4. Module Courses

Course Title	Type	SWH	CP	P/W/WP	WS/SS
Renewable Power Technologies	IV	4	6	P	WS

Course Title	Docent/Lecturer	Language
Renewable Power Technologies	RENAC – various Specialists	English

5. Description of Teaching Mode

This module is offered as a blended mix of instructor-led seminar, exercises, hands-on practical training in the renewable energy technology training center, student contribution (graded presentation of selected topics by each student) and field trip.
A challenging assignment in which students will have to propose an optimized design of a renewable energy based energy supply system will be issued to students during the course. The assignment will have to be carried out by small working groups.

6. Condition for Participation

Mandatory: -
Preferable: -

7. Teaching and learning activities (Effort and Credit Points)

Contact hours 64, 56 hours post - processing and homework, 60 hours preparation for examination/assignment
Total: 180 hours = 6 CP (30 hours = 1 CP).

8. Assessment criteria (Examination and Grades)

Examination:
Portfolio Examination according to examination regulations, Section 12.
Prerequisites for admission to oral/written examination:
80% participation in lectures and exercises; participation in field trip
Grading:
50% individual presentation (15 min per student)
50% result of written group assignment (homework: Renewable Energy Region)

9. Duration of Module

The module can be performed within one semester.

10. Number of Participants

Limited to 20 participants.

11. Inscription Formalities

Registration at the GPE-Student office according to the GPE study and examination regulations.
Dates and deadlines will be announced by semester start.

Module Title: *PV Systems/Solar Cells*	**CP (ECTS):** 12	**Acronym:** PVSS17	**Module Group**: Engineering
Responsible for Module: PD Dr. rer. Nat. Thomas Dittrich	**Secretary:** PTZ 2	**E - mail:** dittrich@helmholtz-berlin.de	

Module Description

1. Qualification Goals

This module explains solar cells as central PV system components, including their basic function and physical principles including semiconductor materials utilized for solar cells, bandwidth of the different types of existing solar cells as well as their differences and efficiency limitations. A brief introduction into feedstock of substances and principles of selected production processes with regard to materials parameters will be additionally given. The students will get an overview about the different kinds of solar cells, their advantages and disadvantages.

The module imparts predominantly the following competence:

Technical 40%	Methodical 30%	Systematical 15%	Social 15%

2. Contents

- Introduction into photovoltaics
- basic characteristics of a solar cell
- optical properties of semiconductors and photocurrent
- electronic properties of semiconductors and photovoltage
- losses in solar cells due to recombination processes in semiconductors
- semi-infinite pn-junction and diode saturation current density
- finite pn-junction and role of recombination
- maximum efficiency of solar cells from detailed balance
- Crystalline Si solar cells
- Thin film photovoltaics
- III-V semiconductor solar cells
- Concentrator solar cells
- alternative concepts I: Dye-sensitized solar cells
- alternative concepts II: Organic solar cells
- alternative concepts III: solar cells with extremely thin absorber
- Solar Modules

3. Literature and Script

Printed and/or electronic scripts as announced in the lectures.

4. Module Courses

Course Title	Type	LSW	CP	P/W/WP	WS/SS
PVS Solar Cells Lecture	VL	4	6	P	WS
PVS Solar Cells Exercise	UE	2	3	P	WS
PVS Solar Cells Seminar	SE	2	3	P	WS

Course Title	Docent/Lecturer	Language
PVS Solar Cells Lecture	PD Dr. rer. Nat. T. Dittrich	English
PVS Solar Cells Exercise	PD Dr. rer. Nat. T. Dittrich/ Tutors	English
PVS Solar Cells Seminar	PD Dr. rer. Nat. T. Dittrich/ Tutors	English

5. Description of Teaching Mode

Contents are presented in lectures illustrated by case studies. In exercises student's abilities are trained by using computers. Challenging tasks for a respective master thesis are continuously provided.

6. Condition for Participation

Mandatory: rough knowledge about value creation in the solar industry, especially in solar manufacturing.
Preferable: none

7. Teaching and learning activities (Effort and Credit Points)

Lectures and exercises: 112 hours contact, 198 hours post-processing and homework, 50 hours reading.
Total: 360 hours = 12 CP (30 hours = 1 CP).

Module Title: *PV Systems/Solar Cells*	**CP (ECTS):** 12	**Acronym:** PVSS17	**Module Group**: Engineering

8. Assessment criteria (Examination and Grades)

Examination:
Portfolio Examination according to examination regulations, Section 12.
Prerequisites for admission to oral/written examination:
Participiation in Exercise and Seminar is mandatory.
Grading:
100% lecture.

9. Duration of Module

The module can be performed within one semester.

10. Number of Participants

Limited to 30 participants.

11. Inscription Formalities

Registration at the GPE-Student office according to the GPE study and examination regulations.
Dates and deadlines will be announced by semester start.

Module Title:	**CP (ECTS):**	**Acronym:**	**Module Group:**
PV Systems/Components	6	PVSC17	Engineering
Responsible for Module:	**Secretary:**	**E - mail:**	
Prof. Dr.-Ing. habil. Rolf Hanitsch	GPE	r-e.hanitsch@t-online.de	

Module Description

1. Qualification Goals

The module gives a review of basic concepts and aspects of electrical engineering used in photovoltaic systems engineering. It shall give an overview over electrical properties of devices and procedures used in conjunction with PV power systems. The module will also provide a theoretical basis for the labs within the module PV systems.

The module imparts predominantly the following competence:

Technical 40%	Methodical 30%	Systematical 15%	Social 15%

2. Contents

1. Lecture & Exercise "Electrical engineering for solar technology"

- DC-Circuits: Voltage, current, Ohm's-Law, resistor, Kirchhoff's-Laws
- parallel & series connection, Sources, voltage & current divider, power, networks
- AC-Circuits: Complex notation, complex impedance & admittance, average & RMS values
- 3-phase systems, star-delta transformation, ac-power, utility grid
- Inductor/Capacitor: Definitions, parallel & series connection, harmonic and time response, energy storage
- Switching & other special circuits: Function principle, MOSFET, switching behavior, basic amplifier circuits, Electronic load, battery charging procedures, switch-mode power supplies, diodes

2. Lecture & Exercise "Components of PV Systems"

- Solar radiation flux: Celestial mechanics, solar radiation components
- PV power systems: Types of PV power systems (island, grid-connected), interconnection
- Photovoltaic generator: Cells, modules, construction principles, shading influence
- Power conditioning 1: DC-DC converter, MPP-tracker, loads
- Power conditioning 2: Batteries, Battery management, DC-AC inverters
- System and component sizing: Methods of system sizing, component interaction and sizing
- Measuring techniques: I/V, power, temperature, intensity, electronic load, lock-in amp, scope

3. Literature and Script

Printed and/or electronic scripts as announced in the lectures.

4. Module Courses

Course Title	Type	LSW	CP	P/W/WP	WS/SS
PV Systems/Components: Lecture	VL	2	3	P	WS
PV Systems/Components: Exercise	UE	2	3	P	WS

Course Title	Docent/Lecturer	Language
PVS Components Lecture	Prof. Dr.-Ing. habil. R. Hanitsch	English
PVS Components Exercise	Tutor	English

5. Description of Teaching Mode

Contents are presented in lectures illustrated by case studies. In exercises student's abilities are trained by using computers. Challenging tasks for a respective master thesis are continuously provided.

6. Condition for Participation

Mandatory: rough knowledge about value creation in the solar industry, especially in solar manufacturing.
Preferable: none

7. Teaching and learning activities (Effort and Credit Points)

Lectures and exercises: 50 hours contact, 90 hours post-processing and homework, 25 hours reading.
Total: 180 hours = 6 CP (30 hours = 1 CP).

Module Title:	**CP (ECTS):**	**Acronym:**	**Module Group:**
PV Systems/Components	6	PVSC17	Engineering

8. Assessment criteria (Examination and Grades)

Examination:
Portfolio Examination according to examination regulations, Section 12.
Prerequisites for admission to oral/written examination:
Participation in exercise
Grading:
100% lecture.

9. Duration of Module

The module can be performed within one semester.

10. Number of Participants

Limited to 30 participants.

11. Inscription Formalities

Registration at the GPE-Student office according to the GPE study and examination regulations.
Dates and deadlines will be announced by semester start.

Module Title: *Solar Thermal Systems I – Fundamentals*	**CP (ECTS):** 6	**Acronym:** STS-IF	**Module Group:** Engineering
Responsible for Module: Prof. Dr-Ing. Ziegler	**Secretary:** KT 2	**E - mail:** Felix.Ziegler@tu-berlin.de	

Module Description

1. Qualification Goals

This module provides an overview of the components in solar thermal systems, with an introduction and explanation of the design and function of individual components. These include solar collectors, solar storage units, circulation pumps, valves, expansion tanks etc. Students are provided with information on quality criteria and are made familiar with the criteria important for selecting individual components or whole systems.

The module is completed by exercises, lab courses, and excursions.

Students will have learnt how solar thermal systems operate. They will be able to judge their quality and potential areas of application.

The module imparts predominantly the following competence:

Technical 40%	Methodical 30%	Systematical 20%	Social 10%

2. Contents

Physics

- Basics in thermodynamics
- Heat transfer (conduction, convection, radiation)
- Basics in fluid mechanics

Components

- Solar Collectors
  - Task, function and characteristic values
  - Collector types
  - Flow type and hydraulic characteristics
- Solar Storage Unit
  - Function and Requirements
  - Types of construction and advanced storage technologies
- Heat Exchangers
  - Function and requirements
  - Construction types

Collector Loop

- Types of systems
- Heat transfer fluids and characteristics
- Circulating pumps and other Accessories

3. Literature and Script

Printed and/or electronic scripts as announced in the lectures.

4. Module Courses

Course Title	Type	LSW	CP	P/W/WP	WS/SS
Solar Thermal Components and Systems Lecture	VL	2	3	P	WS
Solar Thermal Components and Systems Exercise	UE	2	3	P	WS

Course Title	Docent/Lecturer	Language
Solar Thermal Components and Systems Lecture	Dipl.-Ing. R. Buchholz	English
Solar Thermal Components and Systems Exercise	Dipl.-Ing. C. Pataizoglou	English

5. Description of Teaching Mode

Contents are presented in lectures illustrated by case studies. In exercises student's abilities are trained by using computers. Challenging tasks for a respective master thesis are continuously provided.

Module Title:	**CP (ECTS):**	**Acronym:**	**Module Group:**
Solar Thermal Systems I – Fundamentals	6	STS-IF	Engineering

6. Condition for Participation

a) Mandatory: none
b) Preferable: rough knowledge about value creation in the solar industry, especially in solar manufacturing

7. Teaching and learning activities (Effort and Credit Points)

Lectures: 30 hours contact, 25 hours post - processing and homework, 20 hours reading, 15 hours preparation for examination
Exercises: 30 hours contact, 25 hours post - processing and homework, 20 hours reading, 15 hours preparation for examination
Total: 180 hours = 6 CP (30 hours = 1 CP).

8. Assessment criteria (Examination and Grades)

Examination:
Written examination according to examination regulations, Section 11.
Prerequisites for admission to oral/written examination:
Passing all exercises.
Grading:
100% written examination.

9. Duration of Module

The module can be performed within one semester.

10. Number of Participants

Up to 50 participants.

11. Inscription Formalities

Registration at the GPE-Student office according to the GPE study and examination regulations.
Dates and deadlines will be announced by semester start.

Module Title: *Utilization of Wind Energy*	**CP (ECTS):** 6	**Acronym:** WT17	**Module Group:** Engineering
Responsible for Module: Prof. Dr.-Ing. Paul Uwe Thamsen	**Secretary:** K2	**E - mail:** Jan.Liersch@fsd.tu-berlin.de	

Module Description

1. Qualification Goals

Wind Turbine Lecture:
The students know how about main concepts and components of wind turbines and how they are designed with respect to rotor aerodynamics.
The students know the conversion of the power flow from the wind power to the electrical power to the grid as well as the aerodynamic and mechanical behaviour of rotor blades, drive train and elektrical components like generator and power converter. This leads to the knowledge of the characteristic curves of a wind turbine.
Wind Farms and Turbine Characteristics:
The student know how to assess possible sites for future wind farms (basically site assesment) and how to operate, control and maintain wind turbines in generell. They know the dynamically behaviour of a wind turbine and how to evaluate these. Beside that they know the characteristics of a wind turbine operational aspects.
Wind Turbine Project:
The students know in generell how to design a rotor blade for wind turbines. They know how to design it for aerodynamic and load demands. They are able to identify and verify the influences to improve the rotor blade geometries.

The module imparts predominantly the following competence:

Technical 35%	Methodical 30%	Systemic 20%	Social 15%

2. Content

Wind Turbine Basics

- Introduction to the utilization of wind power; Aerodynamics of wind turbines; Electrical system of wind turbines; Components and concepts of wind turbines; Controller concepts of wind turbines; exam

Wind Farms and Turbine Characteristics

- Wind farm planning; Technical Operation of wind farms; Dynamics of wind turbines; Experimental investigation of wind turbine characteristics with the WindLab; presentation of experimental findings

Wind Turbines Project

- Design of wind turbines; Development of rotor blades; Selection of airfoils and aerodynamic properties
- Simulation of wind turbine power; Certification and load calculation; Design of rotor blades in teams; Verification measurement of 3D printed blades; Presentation of project results

3. Literature and Script

Literature, as announced in lectures according to respective subjects.

- Gasch/Twele: Wind Power Plants, Springer
- Hansen: Aerodynamics of Wind Turbines, Earthscan
- Heier: Grid Integration of Wind Energy Conversion Systems, Wiley
- Printed and/or electronic scripts as announced in lectures.

4. Module Courses

Course Title	**Type**	**SWH**	**CP**	**P/W/WP**	**WS/SS**
Wind Turbines Basics	IV	2	3	P	SS
Wind Farms and Turbine Characteristics	SE	2	3	WP	SS
Wind Turbines Project	PJ	2	3	WP	WS

Course Title	**Docent/Lecturer**	**Language**
Wind Turbines Basics	Jan Liersch/ Staffan Wiens	English
Wind Farms and Turbine Characteristics	Jan Liersch/ Maik Wagner	English
Wind Turbines Project	Staffan Wiens/ Maik Wagner	English

5. Description of Teaching Mode

Module Title: *Utilization of Wind Energy*	**CP (ECTS):** 6	**Acronym:** WT17	**Module Group:** Engineering

Content is presented in lectures illustrated by case studies and exercises with calculations and examples. Challenging tasks for a respective master thesis are continuously provided in cooperation with industrial development partners.

6. Condition for Participation

Mandatory: none
Preferable: Renewable Power Technologies, Manufacturing of Wind Turbine Components, Engineering Design and CAD Modeling

7. Teaching and learning activities (Effort and Credit Points)

Wind Turbines Basics:
30 hours contact, 20 hours reading, 20 hours homework, 20 hours preparation for examination
Wind Farms and Turbine Characteristics:
30 hours contact, 10 hours reading, 30 hours pre- and post - processing, 10 hours preparation for the presentation, 10 hours preparation for examination
Wind Turbines Project:
30 hours contact, 40 hours design work and documentation, 10 hours pre- and post - processing, 10 hours preparation for presentation
Total: 180 hours = 6 CP (30 hours = 1 CP).

8. Assessment criteria (Examination and Grades)

Examination:
Portfolio Examination according to examination regulations, Section 12.
Grading:
50% Lecture (written test): 60 min and
50% Wind Farms (final group presentation: 10 min per student and individual oral review: 10 min) or 50% Project (final group presentation: 10 min per student and individual oral review: 10 min)

9. Duration of Module

The full module can be performed within one semester.

10. Number of Participants

Wind Turbines Basics
- is limited to a maximum of 48 participants

Wind Farms and Turbine Characteristics:
- will only be conducted provided that a minimum number of 8 participants is reached
- is limited to a maximum of 24 participants

Wind Turbines Project:
- will only be conducted provided that a minimum number of 8 participants is reached
- is limited to a maximum of 24 participants

11. Inscription Formalities

Registration at the GPE-Student office according to the GPE study and examination regulations.
Dates and deadlines will be announced by semester start.

Module Title: *Mathematical Tools for Engineering and Management*	**CP (ECTS):** 6	**Acronym:** MfE17	**Module Group** Engineering
Responsible for Module: Ph.D. Fabio D'Andreagiovanni	**Secretary:** PTZ 2	**E - mail:** d.andreagiovanni@zib.de	

Module Description

1. Qualification Goals

Modern engineering and management requires the replacemant of traditional trial and error approaches by formal methods. This teaching module addresses this issue. It covers mathematical modelling and solution techniques, that lead to a clear understanding of the quantitative aspects of manufacturing processes and their relations to resource and budget constraints, market forces, and technological innovation. Students will be enabled to understand the main mathematical techniques employed in this area and to judge their appropriateness for particular instances in production engineering and management. After completion of this module, students are qualified to deal with complex quantitative decisions in a systematic way by exploitation of the appropriate decision support tools.

The module imparts predominantly the following competence:

Technical 20%	Methodical 50%	Systemic 20%	Social 10%

2. Contents

Mathematical Tools for Engineering and Management

Basic probability (discrete and continuous random variables), statistical sampling and regression. The course aims at conveying a thorough understanding of the fundamental concepts and how they are used in modeling real world problems. Theory and practice of modelling and solution techniques from mathematical areas such as: linear, nonlinear, integer and stochastic programming, combinatorial optimization, discrete mathematics, stochastics and statistics, regression and decision tree analysis. Algorithms like Branch & Bound and cutting planes are discussed. Lot sizing and multicriteria optimization are introduced.

State of the art practical case studies in the area of production engineering serve as specific examples for Mathematical Tools for Engineering and Management. Digital tools are used in order to determine optimal solutions.

3. Literature and Script

- D. Bertsimas and R. M. Freund, *Data, Models, and Decisions: The Fundamentals of Management Science*, South-Western Educational Publishing.
- J. L., Higle, *Stochastic Programming: Optimization When Uncertainty Matters*, Chapter 2 in: Tutorials in Operations Research, 2005.
- AIMMS – The Modelling System, Version 3.6, www.aimms.com

Printed and/or electronic scripts as announced in lectures.

4. Module Courses

Course Title	**Type**	**SWH**	**CP**	**P/W/WP**	**WS/SS**
Mathematical Tools for Engineering and Management	IV	4	6	P	WS

Course Title	**Lecturer**	**Language**
Mathematical Tools for Engineering and Management	Ph.D. Fabio D'Andreagiovanni	English

5. Description of Teaching Mode

The mathematical theory and algorithms are presented in lectures. Applications from engineering, business, and economics are utilized to convey the impact of this methodology. The exercises aim at training the mathematical approach to problem solving and teach, in particular, modelling techniques. Various software products are used to solve the models, in particular AIMMS and Microsoft Excel. Mathematical methods will be applied to solving production engineering related case studies. Interpretation of the results is an integral part of the mathematical solution cycle. Case studies, carried out in teams, add to the understanding of the importance of teamwork in the solution of complex business and engineering problems.

The teaching mode: Blended learning. Seminars take place in the beginning, in the middle and by end of the teaching period. Teleconference-meetings are offered.

Module Title: *Mathematical Tools for Engineering and Management*	**CP (ECTS):** 6	**Acronym:** MfE17	**Module Group** Engineering

6. Condition for Participation

Mandatory: Basic knowledge in linear algebra, calculus basic.
Preferable: None

7. Teaching and learning activities (Effort and Credit Points)

Lectures: 60 hours contact, 30 hours post-processing and homework, 30 hours reading, 60 hours preparation for examination.
Total: 180 hours = 6 CP (30 hours = 1 CP).

8. Assessment criteria (Examination and Grades)

Examination:
Portfolio Examination according to examination regulations, Section 12.
Prerequisites for admission to oral/written examination:
Passing all exercises.
Grading:
Test, max. 90 min.

9. Duration of Module

The module can be performed within one semester.

10. Number of Participants

Limited places according to infrastructural requirements e.g. computer terminals, software licenses, task elements in practical cases etc.

11. Inscription Formalities

Registration at the GPE-Student office according to the GPE study and examination regulations.
Dates and deadlines will be announced by semester start.

C Module Group Management

Module Title: *Global Production Management*	**CP (ECTS):** 12	**Acronym:** GPM	**Module Group**: Management
Responsible for Module: Prof. Dr.-Ing Holger Kohl	**Secretary:** PTZ - 9	**E - mail:** holger.kohl@tu-berlin.de	

Module Description

1. Qualification Goals

The GPM teaching module provides knowledge about integrated manufacturing management tasks such as planning, scheduling and evaluation of manufacturing processes and facilities.
Students will be prepared for a systematic manufacturing management regarding micro- and macro-economic matters that consider relevant decision criteria in the framework of global conditions.
By applying scientific methods of corporate management and knowledge of global and economic relations, the students are prepared for planning and leading production.

The module imparts predominantly the following competence:

Technical 25%	Methodical 40%	Systemic 25%	Social 10%

2. Contents

World Trade institutions and organizations; the European Union and globalization; trade barriers; enterprise types; global business and culture; global manufacturing strategy; procurement, global logistics; logistics control; just-in-time production; lean management; reengineering; planning of enterprises; simulation; location planning; benchmarking; knowledge management; management systems; production control; supply chain management, global research.

3. Literature and Script

Electronic scripts as announced in lectures.

Literature:

- Kohl, H.; Riebartsch, O.: Sustainable key-figure Benchmarking for small and medium sized Enterprises. In: Seliger, G. (Hrsg.): Sustainable Manufacturing: Shaping Global Value Creation. Springer, Heidelberg, 2012.
- Kohl, H.; Al Hashemi, H.: Science Parks as main driver for the development of National Innovation Systems in resources-driven economies! The importance of Intellectual Capital Management for Sustainable Manufacturing. In: Seliger, G.; Khraisheh, M.; Jawahir, I. S. (Hrsg.): Advances in Sustainable Manufacturing. Springer-Verlag, Heidelberg, 2011, S. 45-50.
- Jochem, R.; Mertins, K.; Knothe, T. (Hrsg.): Prozessmanagement. Symposion, Düsseldorf 2010.
- Mertins, K.; Kohl, H. (Hrsg.): Benchmarking: Leitfaden für den Vergleich mit den Besten (mit CD-ROM). Symposium, Düsseldorf, 2009.
- Kai Mertins, Holger Seidel (Hrsg.): Wissensmanagement im Mittelstand. Springer Verlag, Berlin 2009.
- Kai Mertins, Peter Heisig, Jens Vorbeck: Knowledge Management. Berlin: Springer 2003.

Details to further additional readings will be given in the courses.

4. Module Courses

Course Title	Type	SWH	CP	P/W/WP	WS/SS
Global Production Management I	VL	2	3	P	WS
Methods and Tools for Global Production Engineering I	UE	2	3	P	WS
Global Production Management II	VL	2	3	P	SS
Methods and Tools for Global Production Engineering II	UE	2	3	P	SS

Course Title	Docent/Lecturer	Language
Global Production Management I	Prof. Dr.-Ing Holger Kohl	English
Methods and Tools for Global Production Engineering I	Prof. Dr.-Ing Holger Kohl	English
Global Production Management II	Prof. Dr.-Ing Holger Kohl	English
Methods and Tools for Global Production Engineering II	Prof. Dr.-Ing Holger Kohl	English

5. Description of Teaching Mode

The modules consist of the lectures (VL), the supplementary and exemplifying exercises on Methods and Tools for Global Production Management (UE).

Module Title: *Global Production Management*	**CP (ECTS):** 12	**Acronym:** GPM	**Module Group**: Management

Explorative, situational and problem-oriented teaching methods will be used to provide knowledge and skills. Technical as well as methodical contents will be taught, while real/relevant cases are applied and discussed. In order to successfully pass the module, it is necessary to participate in all courses.

In exercises students are motivated to work on lecture topics using presentations of their home country's status in the world economy in figures and interpretations and by application of the methods and tools in concrete example applications, mostly in teamwork.

6. Condition for Participation

Mandatory: 80% participation in lectures and exercises
Preferable: 100% participation in lectures and exercises

7. Teaching and learning activities (Effort and Credit Points)

Contact hours: 116, Homework: 60 h, Course preparation and post-processing: 124 h,
Exam preparation: 60 h
Total: 360 hours = 12 CP (30 hours = 1 CP).

8. Assessment criteria (Examination and Grades)

Examination:
Portfolio Examination according to examination regulations, Section 12.
Prerequisites for admission to oral/written examination:
Passing country presentation and written homework.
Grading:
20% presentation + 30% written homework + 50% exam.

9. Duration of Module

The module can be completed within two semesters.

10. Number of Participants

Lectures and exercises are limited to 40 participants each.

11. Inscription Formalities

Registration at the GPE-Student office according to the GPE study and examination regulations.
Dates and deadlines for country presentation, homework and exam will be announced at the beginning of each semester.

Module Title: *Quality Management*	**CP (ECTS):** 12	**Acronym:** QM	**Module Group:** Management
Responsible for Module: Prof. Dr.-Ing. Roland Jochem	**Secretary:** PTZ 3	**E - mail:** *roland.jochem@tu-berlin.de*	

Module Description

1. Qualification Goals

In the last decade product quality and the level of services have become a decisive competition factor. Product quality, however, cannot be ensured unless the production processes and working methods helping to create the specific products equally meet quality requirements and so does the management controlling the above.
The most important quality requirement of processes is described by the statistical basic standards of the process capacity. Therefore, the curriculum focuses on the Set of Standard Specifications ISO 9000 and following, a specific standard specifications, which set requirements to the quality management system of organisations. The topic will be completed with the description of the actual certification process.
Quality management in its current language usage includes all organisation's quality related activities. It also includes a number of leadership activities, which are particularly stressed upon by the curriculum. The same also presents the workers' quality orientated mindset. Also on the agenda are up - to - date leadership styles and structure of quality conception. That subject also covers the various forms of the groupwork within the enterprise also known as quality circleproject groups and workshops, featuring individually developed problem solving techniques. A part of the curriculum is devoted to "Quality and the term: economical". The specific topic includes the well known concepts on identification and reporting on the quality - related costs, as well as the term "quality - controlling". In parallel with this topic the curriculum deals with the latest legal practice on the liability for quality. The risks of the latter should be prevented through an adequate organisation. Finally, the concept of total quality management TQM is described.
This is an all - embracing management method targeting a long - term business success via the satisfaction of customers. It also strives to correspond to the requirements of the other partners of the work - processes, that is: employees, suppliers, funding providers and society.

The module imparts predominantly the following competence:

Technical 30%	Methodical 30%	Systemic 20%	Social 20%

2. Contents

Quality Management I (4 SWH)

- History of quality management
- Quality requirements
- Set of standard specifications ISO 9000 et seq
- Quality circle and product development process
- Probability calculus and statistics
- Techniques of quality management in product planning, product development, acquisition, as well as during production

Quality Management II (4 SWH)

- Tasks of the leadership during quality management
- Problem - solving methods
- Quality management in the area of services
- Quality and the term "ecological"
- Quality controlling
- Total productive maintenance
- Product liability
- Total quality management

3. Literature and Script

- James R. Evans. William R. Lindsay, *The Management and Control of Quality*, West Publishing Company.
- Keki R. Bhote, Adi K. Bhote, *World Class Quality*, AMACOM.
- Kostka, C., Mönch, A., *Change Management*, 2004.

Printed and/or electronic scripts as announced in lectures.

4. Module Courses

Course Title	Type	SWH	CP	P/W/WP	WS/SS
Quality Management I	VL	2	3	P	WS
Quality Management Exercise I	UE	2	3	P	WS
Quality Management II	VL	2	3	P	SS
Quality Management Exercise II	UE	2	3	P	SS

Module Title: *Quality Management*	**CP (ECTS):** 12	**Acronym:** QM	**Module Group:** Management

Course Title	Docent/Lecturer	Language
Quality Management I	Prof. Dr.-Ing. Roland Jochem	English
Quality Management Exercise I	Falk Behmer/Laura Homma	English
Quality Management II	Prof. Dr.-Ing. Roland Jochem	English
Quality Management Exercise II	Falk Behmer/Christoffer Rybski	English

5. Description of Teaching Mode

In the lectures, basic knowledge and techniques of Quality Management are imparted. Detailed and practical knowledge and techniques are trained in six exercises. In case studies, the students learn in small groups how to apply the techniques and have to present their results at the end of the course.

6. Condition for Participation

Mandatory: Profound English proficiency
Preferable: Basic knowledge of business economics and of team work techniques

7. Teaching and learning activities (Effort and Credit Points)

Lectures: 60 hours contact, 45 hours post - processing and homework, 45 hours reading, 30 hours preparation for examination
Exercises: 60 hours contact, 45 hours preparation, 45 hours documentation, 30 hours preparation for examination
Total: 360 hours = 12 CP (30 hours = 1 CP).

8. Assessment criteria (Examination and Grades)

Examination:
Portfolio Examination according to examination regulations, Section 12.
Prerequisites for admission to oral/written examination:
None.
Grading:
50% Test – 90 min.
25% QM Exercise I: 75% Group Report; 25% Group presentation
25% QM Exercise II: 75% Group Report; 25% Group presentation

9. Duration of Module

The module can be performed within two semesters.

10. Number of Participants

The lectures are not limited; Exercises are limited to a number of 40 participants.

11. Inscription Formalities

Registration at the GPE-Student office according to the GPE study and examination regulations.
Dates and deadlines will be announced by semester start.
Exercise groups will be determined in the first lecture.

Module Title: *Environmental Management*	**CP (ECTS):** 6	**Acronym:** EM	**Module Group:** Management
Responsible for Module: Dr.-Ing Elisabeth Strecker	**Secretary:** CR - 2	**E - mail:** e.strecker@tu-berlin.de	

Module Description

1. Qualification Goals

The goals are to gain applicable knowledge of elements of environmental management systems. The mastery tools for environmental management systems and the mastery of techniques for implementation of environmental management systems will enable students to design environmental management systems. The students will become motivated to environmental protection and to implement of environmental management systems.

The module imparts predominantly the following competence:

Technical 30%	Methodical 30%	Systemic 20%	Social 20%

2. Contents

The course explains causes of environmental problems and gives historical and political background information of environmental management. The students gain information about chances and risks. Environmental management will be discussed as a knowledge domain with elements of environmental management systems including issues on background, goals, body of regulations and their requirements and realization. In conclusion, the application in business and integration of management systems is considered with examples from industry.

3. Literature and Script

- ISO 14.001:2004 ff.
- Regulation (EC) No 761/2001 of the European Parliament and of the Council of 19 March 2001 allowing voluntary participation by organisations in a Community eco - management and audit scheme (EMAS).
- http://europa.eu.int/comm/environment/emas.
- http://www.envirowise.gov.uk.

4. Module Courses

Course Title	Type	SWH	CP	P/W/WP	WS/SS
Environmental Management	IV	4	6	P	WS

Course Title	Docent/Lecturer	Language
Environmental Management	Dr.-Ing Elisabeth Strecker	English

5. Description of Teaching Mode

Lecture, work out and discussion, exercise with character of a business game in team work, presentation and discussion.

6. Condition for Participation

Mandatory: None
Preferable: Industry knowledge

7. Teaching and learning activities (Effort and Credit Points)

60 hours contact, 60 hours preparation of presentation, 60 hours preparation of a home work as final examination.
Total: 180 hours = 6 CP (30 hours = 1 CP).

8. Assessment criteria (Examination and Grades)

Examination:
Portfolio Examination according to examination regulations, Section 12.
Prerequisites for admission to oral/written examination:
None.
Grading:

Module Title: *Environmental Management*	**CP (ECTS):** 6	**Acronym:** EM	**Module Group**: Management
100% lecture.			

9. Duration of Module
The module can be performed within one semester.

10. Number of Participants
The number of this course is limited to a maximum of 25 participants.

11. Inscription Formalities
Registration at the GPE-Student office according to the GPE study and examination regulations. Dates and deadlines will be announced by semester start.

Module Title: *Project Management*	**CP (ECTS):** 6	**Acronym:** PM17	**Module Group**: Management
Responsible for Module: Dr.-Ing. Wolfgang Glitscher	**Secretary:** PTZ 2	**E - mail:** dreip-consult@outlook.com	

Module Description

1. Qualification Goals

The teaching module deals with **Project Management** as an instrument for the realisation of projects in the production environment. Students will be enabled to set up planning processes in projects, management of on-going projects, learn how to use the instruments of risk- and quality - management for projects and how to set up communication and negotiation processes. They will be enabled to use the management instruments consequently.

The module imparts predominantly the following competence:

Technical 30%	Methodical 30%	Systemic 10%	Social 30%

2. Contents

Integration management, Scope management, Time management, Cost management, Quality management, Risk management, Resource deployment management, Communication management, Procurement management

3. Literature and Script

Printed and/or electronic scripts as announced in lectures.

4. Module Courses

Course Title	Type	SWH	CP	P/W/WP	WS/SS
Project Management - Lecture	VL	2	3	P	WS
Project Management – Case Studies Group 1	SE	2	3	WP	WS
Project Management – Case Studies Group 2	SE	2	3	WP	WS

Course Title	Docent/Lecturer	Language
Project Management – Lecture	Dr.-Ing Wolfgang Glitscher	English
Project Management – Case Studies Group 1	Dr.-Ing Wolfgang Glitscher	English
Project Management – Case Studies Group 2	Dr.-Ing Wolfgang Glitscher	English

5. Description of Teaching Mode

The theoretical basis of **Project Management** is presented during the VL course Project Management. This will be illustrated by examples.
In the course "**Project Management – Case Studies**" students' learn to apply the theoretical basis of Project Management by analyzing several case studies from the industrial and organizational environment. A special focus is set on the area of Project Risk Management.

6. Condition for Participation

Mandatory: None
Preferable: None

7. Teaching and learning activities (Effort and Credit Points)

Project Management:
30 hours exam preparation, 30 hours contact, 30 hours preparing class by reading.
Project Management – Case Studies:

40 hours block seminar (contact), 25 hours preparing class by reading, 25 hours analyzing case studies and preparing presentation

Total: 180 hours = 6 CP (30 hours = 1 CP).

8. Assessment criteria (Examination and Grades)

Examination:
Portfolio Examination according to examination regulations, Section 12.

Module Title: *Project Management*	**CP (ECTS):** 6	**Acronym:** PM17	**Module Group**: Management

Prerequisites for admission to oral/written examination:
None.
Grading:
50 % lecture, 50% seminar

9. Duration of Module

The module can be performed within one semester.

10. Number of Participants

Group 2 will only be offered upon request and depends on the number of students applied for the module
The number of students is maximum 50 participants.

11. Inscription Formalities

Dates and deadlines will be announced by semester start.
Course for credits only.

Module Title: *Logistics*	**CP (ECTS):** 6	**Acronym:** LOG17	**Module Group**: Management
Responsible for Module: Prof. Dr.-Ing. F. Straube	**Secretary:** H 90	**E - mail:** straube@logistik.tu-berlin.de	

Module Description

1. Qualification Goals

This module focuses state-of-the art approaches for managing logistics systems. Students will learn about examples of sustainable supply chains, based on which they will be able to identify and study important building blocks, repeating patterns and theoretical concepts crucial to supply chain design and strategy. Thereupon, they will get to know the most important elements of logistics systems . A strong focus will be placed on the transferability of gained knowledge into practice by using case studies. Students know about latest technologies for inhouse logistics planning. Discussions, student presentation and classroom interaction will lead to a thorough understand of the topic.

The module imparts predominantly the following competence:

Technical 20%	Methodical 40%	Systemic 20%	Social 20%

2. Contents

The lecture **Logistics Systems** is especially focused on methods of designing and planning logistics systems. Further topics of this course are information technologies in logistics, elements of transportation systems, automated systems of supply and disposal for production and assembly, and systems in warehousing and picking. AutoID technologies such as barcode, radio-frequency identification, storagin, automated guided vehicles and rack feeders are adressed.

Sustainable Logistics course offers an exclusive opportunity to study and discuss about sustainability issues, understanding how the most sustainable companies in Germany are implementing changes in their supply chain in order to reduce environmental, social and economic impacts.

International Procurement covers the specific challenges of international sourcing in emerging as well as developed markets. The objective is to gain an overview of the chances and risks of this procurement process and to learn practical methods for dealing with sourcing methods. For instance, the course focuses on both the sourcing strategies in emerging markets and requirements for an integrated supplier management. Supplier selection and evaluation based on total costs are either discussed as well as concepts how to handle and avoid quality deficits at suppliers.

3. Literature and Script

Literature, as announced in lectures according to respective subjects.

- Chopra, S./Meindl, P.: Supply Chain Management – Strategy, Planning, & Operations, 4th edition, Upper Saddle River, 2009.
- Simchi-Levi, D/ Kaminski, P./Simchi-Levi, E. – Designing and Managing the Supply Chain: Concepts, Strategies & Case studies, 3rd edition, New York, 2008.
- Various case studies, which will be provided during the course.

Printed and/or electronic scripts as announced in lectures.

4. Module Courses

Course Title	Type	LSW	CP	P/W/WP	WS/SS
Logistic Systems	IV	2	3	P	WS
Sustainable Logistics	IV	2	3	WP	WS
International Procurement	IV	2	3	WP	WS

Course Title	Docent/Lecturer	Language
Logistic Systems	Prof. Dr.-Ing. A. Goldmann	English
Sustainable Logistics	Dr.-Ing Juliana Campos	English
International Procurement	Dr.-Ing. Christian Durach	English

5. Description of Teaching Mode

The respective contents are presented in a lecture including case studies.

Module Title: *Logistics*	**CP (ECTS):** 6	**Acronym:** LOG17	**Module Group**: Management

6. Condition for Participation

Mandatory: none
Preferable: none

7. Teaching and learning activities (Effort and Credit Points)

Logistic Systems:
Contact 28, Preparation for Course 12 Preparation for Examination 20, Homework 30
Sustainable Logistics:
Contact 26, Preparation for course 14, Post-processing 10, Reading 10, Project work 30
International Procurement:
Contact 15, Post-Processing 15, Preparation for Examination 20, Homework 40
Total: 360 hours = 12 CP (1 CP for 30 hours).

8. Assessment criteria (Examination and Grades)

Examination:
Portfolio Examination according to examination regulations, Section 12.
Prerequisites for admission to oral/written examination:
None.
Grading:
Logistic Systems:
Grading is presented in the first lecture.
Sustainable Logistics:
20 % case presentation; 80%, group evaluation - paper about one specific cluster of practices x presented case studies
International Procurement:
30 % case presentation; 70% examination

9. Duration of Module

The module can be performed within one semesters.

10. Number of Participants

Logistic Systems
- is limited to a maximum of 50 participants

Sustainable Logistic
- will only be conducted provided that a minimum number of 5 participants is reached
- is limited to a maximum of 25 participants

International procurement
- will only be conducted provided that a minimum number of 5 participants is reached
- is limited to a maximum of 15 participants

11. Inscription Formalities

Registration at the GPE-Student office according to the GPE study and examination regulations.
Dates and deadlines will be announced by semester start.

Module Title: *Supply Chain Management*	**CP (ECTS):** 6	**Acronym:** SCM17	**Module Group**: Management
Responsible for Module: Prof. Dr. habil Dr. Sc. Mult. D. Ivanov	**Secretary:** H 90	**E - mail:** dmitry.ivanov@hwr-berlin.de	

Module Description

1. Qualification Goals

This module will focus on state-of-the art approaches for designing and planning supply chains. Students will learn about examples of excellent supply chains, based on which they will be able to identify and study important building blocks, repeating patterns and theoretical concepts crucial to supply chain design and strategy. Thereupon, they will get to know the most important concepts of managing supply chains in the medium term, i.e. supply chain planning. A specific focus will be on supply chain planning under uncertainty – one of the most important challenges that companies are facing nowadays. The courses rely heavily on the application of theoretical concepts and techniques to supply chain design and planning. A strong focus will be placed on the transferability of gained knowledge into practice by using case studies. Discussions, student presentation and classroom interaction will lead to a thorough understand of the topic. Comprehensive simulations support the learning experience

The module imparts predominantly the following competence:

Technical 20%	Methodical 40%	Systemic 20%	Social 20%

2. Contents

The integrated course "**Supply Chain Management**" covers fundamental concepts of management in the field of supply chain management, which provides competitive advantage to industry, retailers and service providers. Strategic, planning and operational topics within the entire cycle of supply chain management are introduced, covering processes from purchasing, production planning, transportation management and disposal of goods. Furthermore, market trends, supply chain strategies of companies and supply chain differentiation are discussed. A comprehensive simulation supports the learning experience.

The seminar " **Supply Chain Management**" combines both most recent theoretical concepts and various practice-oriented topics within the field of supply chain management. This seminar will include a project type team assignment to cutting edge supply chain topics like sustainability in supply chains, customer-aligned SCM, resilience, uncertainty, volatility and risk management in SCM and industry-specific concepts. The team projects will be linked to industry-related challenges.

3. Literature and Script

Literature, as announced in lectures according to respective subjects.

- Ivanov D, Tsipoulanidis, A., Schönberger J.: Global Supply Chain and Operations Management: A Decision-Oriented Introduction to the Creation of Value. Springer 2017
- Chopra, S./Meindl, P.: Supply Chain Management – Strategy, Planning, & Operations, 4th edition, Upper Saddle River, 2009.
- Simchi-Levi, D/ Kaminski, P./Simchi-Levi, E. – Designing and Managing the Supply Chain: Concepts, Strategies & Case studies, 3rd edition, New York, 2008.
- Various case studies, which will be provided during the course.

Printed and/or electronic scripts as announced in lectures.

4. Module Courses

Course Title	Type	LSW	CP	P/W/WP	WS/SS
Supply Chain Management	IV	2	3	P	SS
Supply Chain Management Seminar	SE	2	3	P	WS

Course Title	Docent/Lecturer	Language
Supply Chain Management	Prof.Dr. Dmitry Ivanov	English
Supply Chain Management Seminar	Prof.Dr. Dmitry Ivanov	English

5. Description of Teaching Mode

The respective contents are presented in a lecture including case studies. In the seminar, students solve supply chain problems and present their solutions.

Module Title: *Supply Chain Management*	**CP (ECTS):** 6	**Acronym:** SCM17	**Module Group**: Management

6. Condition for Participation

Mandatory: none
Preferable: Logistics

7. Teaching and learning activities (Effort and Credit Points)

Supply Chain Management Lecture:
Contact 28, Preparation for Course 12 Preparation for Examination 20, Homework 30
Supply Chain Management Seminar:
Contact 28, Reading 32, Project work 30

8. Assessment criteria (Examination and Grades)

Examination:
Portfolio Examination according to examination regulations, Section 12.
Prerequisites for admission to oral/written examination:
None.
Grading:
Supply Chain Management:
Grading is based on homework and written tests (50%) and a final exam (50%)
Supply Chain Management Seminar:
Grading in the seminar is based on class participation (40%), presentation (20%) and essay or project report (40%). The students will work in teams for the presentation and essay / project report leading to a grade for the whole team.

9. Duration of Module

The module can be performed within one semester.

10. Number of Participants

The courses are limited to a maximum of 25 participants each.

11. Inscription Formalities

Registration at the GPE-Student office according to the GPE study and examination regulations.
Dates and deadlines will be announced by semester start.

Module Title: *Renewable Markets and Business Management*	**CP (ECTS):** 6	**Acronym:** RMBM17	**Major field:** Management
Responsible for Module: Dr. Christine Wörlen	**Secretary:** PTZ II	**E - mail:** woerlen@arepo-consult.com	

Module Description

1. Qualification Goals

The objective of this module is that students know and understand important non-technical aspects for the successful implementation of renewable energy projects. The module provides insights into business models and markets that are specific for renewable energy technologies. It enables students to understand and create typical and novel renewable energy business models and projects. It also discusses their target markets. Students learn to assess the economics of stand-alone renewable energy systems, captive renewable energy systems and integrated energy service business models. Students will identify, assess and present renewable markets and discuss innovative business models in these markets. They will attempt to understand success factors and barriers to their development. The course thus enables the participants to understand the complexity of marketing technologies. A second task is to re-engineer a business model of an energy company.

The module imparts predominantly the following competence:

Technical 30%	Methodical 30%	Systemic 20%	Social 20%

2. Contents

Global and national markets for (renewable) energy technologies and services
Global historic market overview of traditional and new energy technologies and services; comparison of economic and technical aspects of traditional and new energy technologies and services (including grids and power markets); discussion of exemplary markets and business models (mere technology provision, stand-alone energy projects in on-grid and off-grid situations, internet 4.0-related business models). Country markets: describe the energy market in a country, and three important business models in that market (individual)
Business Plan Development
Understanding the renewables supply chain, Business Model Development (Business case and Business Model, Business planning, Principles of business strategy), Risk, Market analysis (competitors, competing technologies and energy sources, available and new technologies, innovation, availability of work force and education, etc.), Unique selling points. Reengineering of a business model in one of the presentation countries (group task)

3. Literature and Script

Global data:
REN21 global status report, IEA World Energy Outlook, GWEC, Solar Power Europe data and scenarios
Internet Ressources and literature on Renewables market development:
www.solarbuzz.com, www.eupvplatform.org/, Renewable energy barometers, Websites of European and Global associations, Global Status Report (www.ren21.net)
Internet Ressources for developing business plans:
http://www.entrepreneurship.com/tools/pdf/businessPlanWorkbook.pdf, http://www.business-plans.co.uk/
http://www.bizplanit.com/free.html,
http://www.deloitte.com/dtt/cda/doc/content/DI_writing%20business%20plan.pdf, http://www.bplans.com/
Literature on Business Plans
Brian R. Ford a.o.: The Ernst & Young Business Plan Guide, 3rd edition
Richard Stutley: The definitive business plan, revised 2nd edition
Michael O'Donnell: Writing Business Plans That Get Results – A Step-by-Step Guide
Rhonda Abrams: The Successful Business Plan – Secrets and Strategies
Electronic scripts available as announced in lectures.

4. Module Courses

Course Title	Type	SWH	CP	P/W/WP	WS/SS
Renewable Market and Business Management I	IV	2	3	P	SS
Renewable Market and Business Management II	IV	2	3	P	WS

Module Title: *Renewable Markets and Business Management*	**CP (ECTS):** 6	**Acronym:** RMBM17	**Major field:** Management

Course Title	Dozent/Lecturer	Language
Renewable Market and Business Management I	Dr. Christine Wörlen	English
Renewable Market and Business Management II	Dr. Christine Wörlen	English

5. Description of Teaching Mode

Lecturers will give theoretical input on the basic aspects of renewable market development and financing. Students will be involved strongly as they have to present their own findings on a country of their choice and discuss it in class. Students will be asked to reengineer the business plan of a renewable energy business.

6. Condition for Participation

Mandatory: none
Preferably: Renewable Power Technologies, Business Administration, Energy Entrepreneurship and Rural Electrification
Specials:
Participation in RMBMI requires also participation in RMBM II and vice versa.

7. Teaching and learning activities (Effort and Credit Points)

Renewable Market and Business Management I:
28 hours contact, 30 hours post-processing, 10 hours reading, 20 hours preparation for presentation
Renewable Market and Business Management II:
32 hours contact, 30 hours post-processing, 10 hours reading, 20 hours preparation for presentation
Total: 180 hours = 6 CP (30 hours = 1 CP).

8. Assessment criteria (Examination and Grades)

Examination:
Equivalent course work according to examination regulations, Section 12
Prerequisites for admission to oral/written examination:
none
Grading:
Grading RBMB I - 50% of module grade
Country presentation (individual): 40%, 2 Country presentation responses (individual): 20% each,
Participation in class (individual): 20%
Grading RMBM II - 50% of module grade
Report: Reengineered business plan (group): 40%, 2 Business plan responses (individual): 20% each,
Participation in class (individual): 20%

9. Duration of Module

The module can be performed within two semesters.

10. Number of Participants

Limited to 30 students.

11. Inscription Formalities

Registration at the GPE-Student office according to the GPE study and examination regulations. Dates and deadlines will be announced by semester start.

Module Title: *Business Administration*	**CP (ECTS):** 6	**Acronym:** BA17	**Module Group**: Management
Responsible for Module: Dr.–Ing. Christoph von Braun	**Secretary:** PTZ2	**E - mail:** christoph@von-braun.com	

Module Description

1. Qualification Goals

The student knows about the various management functions and roles in the contemporary business environment. He is familiar with accounting and various financial management skills, required to cope with the challenges associated with jobs in an enterprise. Various theoretical concepts and frameworks such as the concept and history of money, business ethics and financial control are discussed and applied with the help of case studies and theoretical teaching material. Case studies will help the participants to have hands on exposure to the management theories and skills.
Moreover, students are enabled to become more effective negotiators in their business life. They know how to shape international negotiation situations.

The module imparts predominantly the following competence:

Technical 20%	Methodical 40%	Systematical 20%	Social/ethical 20%

2. Contents

Business Administration - Financial Management:

- The concept of money
- Revenues and profit
- Cash and other forms of money
- Time value of money
- Depreciation
- Cash flow and liquidity
- Assets and liabilities
- Income Statement
- Balance Sheet
- Financial analysis
- Business ethics

Business Administration - International Negotiation:

- BATNA, anchoring, logrolling, bartering
- positions vs. interests vs. preferences
- negotiation mind sets, psychological biases
- group dynamics, multiparty negotiations
- preparing for a negotiation
- contingent contracts
- protections against hardball tactics/dirty tricks
- cultural aspects of negotiation

3. Literature, Script

Financial Management:

- Financial Accounting for Non-Financial Managers
- Management 9th Edition, Stephen P. Robbins.
- Becoming a Manager: How new managers master the art of leadership by Linda Hill.
- Peter Drucker on the Profession of Management.
- The Case Study Hand Book: How to read, discuss and write persuasively about cases. William Ellet.
- Case Studies from Harvard Business School, ECCH (European case clearing house) and IMD.
- Other reading material will be provided during the course.

Case Studies and International Negotiation:

- Negotiation Genius, Deepak Malhotra and Max Bazerman
- The Mind and Heart of the Negotiator (5th Edition), Leigh Thompson

4. Module Courses

Course Title	Type	SWH	CP	P/W/WP	WS/SS
Business Administration - Financial Management	IV	2	3	P	WS
Business Administration – International Negotiation	IV	2	3	P	WS

Course Title	Docent/Lecturer	Language
Business Administration - Financial Management	Dr. Christoph v. Braun	English
Business Administration - International Negotiation	Valentin Ade	English

Module Title: *Business Administration*	**CP (ECTS):** 6	**Acronym:** BA17	**Module Group**: Management

5. Description of Teaching Mode

Contents of Financial Management are presented in lectures and illustrated in case studies. Moreover, discussion groups will be conducted.
The teaching/learning style for international negotiation is highly interactive, covering theory and practice, e.g. negotiation role-plays.

6. Condition for Participation

Mandatory: None
Preferable: Basic knowledge of business processes in companies

7. Teaching and learning activities (Effort and Credit Points)

Financial Management: 30 hours contact, 30 hours post processing and homework, 30 hours reading.
International Negotiation: 30 hours contact, 30 hours post processing and homework, 30 hours reading.
Total: 180 hours = 6 CP (30 hours = 1 CP).

8. Assessment criteria (Examination and Grades)

Examination:
Portfolio Examination according to examination regulations, Section 12.
Prerequisites for admission to oral/written examination:
None.
Grading:
Financial Management (75%):
Written test (60 min.) 40%; presentation in group 40%, class participation 20%
International Negotiation (25%):
50% individual class participation (including participation during the negotiation exercises); 50% reflective learning journal (group work)

9. Duration of Module

The module can be performed within one semester.

10. Number of Participants

The number of participants for this course is limited to a maximum of 30 students.

11. Inscription Formalities

Registration at the GPE-Student office according to the GPE study and examination regulations.
Dates and deadlines will be announced by semester start.

D Module Group Intercultural Communication

Module Title: *Workshop for Intercultural Communication and Relationships*	**CP (ECTS):** 0	**Acronym:** WICR	**Module Group**: Intercultural Communication
Responsible for Module: Magister Grit Kümmele	**Secretary:** PTZ 2	**E - mail:** georgetown-hu@gmx.de	

Module Description

1. Qualification Goals

The course enables students to understand the range of cultural behaviors and expectations. They learn to identify dominant cultural variables at work by case studies and get to create case studies through the participants.
They will develop key principles for good communication and effective personal attributes within cultures and know how to implement knowledge transfer within different organizational structures and various cultures.

The module imparts predominantly the following competence:

Technical 25%	Methodical 25%	Systemic 25%	Social 25%

2. Contents

The students will learn about the basic constituents of a culture (including enterprise culture) with a special focus on the values and how to use this knowledge for influencing existing enterprise cultures and/or to construct new ones. They will work on their behaviors and communicative skills in intercultural encounters to be able to understand possible intercultural conflicts and to manage them. They will create their own model of an ideal enterprise culture which allows a productive atmosphere at work or in projects.

3. Literature and Script

Printed and/or electronic scripts as announced in lectures.

4. Module Courses

Course Title	Type	SWH	CP	P/W/WP	WS/SS
Workshop for Intercultural Communication and Relationships	SE	0,5	0	P	WS

Course Title	Docent/Lecturer	Language
Workshop for Intercultural Communication and Relationships	Magister Grit Kümmele	English

5. Description of Teaching Mode

Workshop

6. Condition for Participation

Mandatory: None
Preferable: None

7. Teaching and learning activities (Effort and Credit Points)

8 hours contact

8. Assessment criteria (Examination and Grades)

Examination:
Portfolio Examination according to examination regulations, Section 12.
Grading:
no quantity grade is given either “pass” or “fail” – certificate of attendance is required for getting permission to register modules out of module group D

9. Duration of Module

The module must be performed within the first semester.

Module Title: *Workshop for Intercultural Communication and Relationships*	**CP (ECTS):** 0	**Acronym:** WICR	**Module Group**: Intercultural Communication

10. Number of Participants
The number of participants of this course is unlimited; groups will be built up to 15 participants.

11. Inscription Formalities
Mandatory course – no registration required, enrollment for the class is obligatory. Attending and passing this course is a requirement for getting credits within module group D!

Module Title: *German for Engineers*	**CP (ECTS):** 0	**Acronym:** GL17	**Module Group**: Intercultural Communication
Responsible for Module: Christoph Hauser	**Secretary:** PTZ 2	**E - mail:** christophhauser@gmx.net	

Module Description

1. Qualification Goals

The overall goal of German for Engineers is to force communicative competence in daily and academic life. The students will gain language knowledge, vocabulary as well as grammar skills. The students will strenghten their general communicative competences in the German language and develop relevant study techniques. Students will be enabled to read and understand specialised articles. Students learn how to write their CV in German language. German for Engineers strengthens the technical knowledge of students through reading and discussing engineering literature, i.e. literature on lean, production planning, car manufacturing, generators, solar panels etc. Students are enabeled to present scientific content in plenum.

The module imparts predominantly the following competence:

Technical 30%	Methodical 20%	Systemic 20%	Social 30%

2. Contents

Basic German for Engineers I (4 SWH)
Achievement or Expansion of German knowledge
Basic German for Engineers II (4 SWH)
Expansion and strengthening of German knowledge
Basic German for Engineers III (4 SWH)
Expansion and strengthening of advanced German knowledge

3. Literature and Script

Literature: As announced in lectures.
Printed and/or electronic scripts as announced in lectures.

4. Module Courses

Course Title	Type	SWH	CP	P/W/WP	WS/SS
Basic German for Engineers I	IV	4	0	W	WS
Basic German for Engineers II	IV	4	0	W	SS
Basic German for Engineers III	IV	4	0	W	WS

Course Title	Docent/Lecturer	Language
Basic German for Engineers I	Christoph Hauser	German
Basic German for Engineers II	Christoph Hauser	German
Basic German for Engineers III	Christoph Hauser	German

5. Description of Teaching Mode

- Interactive learning
- Project work
- Presentations
- Field trips

6. Condition for Participation

Mandatory: Participation in German Placement Test (offered during the introduction event)
Preferable: Basic German skills

7. Teaching and learning activities (Effort and Credit Points)

64h (WS) 56 (SS) contact time, 50h homework, 20h preparation each semester

Module Title: *German for Engineers*	**CP (ECTS):** 0	**Acronym:** GL17	**Module Group**: Intercultural Communication

8. Assessment criteria (Examination and Grades)

Examination:
No grade is given
Special offer
One Extracurricular German Language Certificate (type will be announced in time)
Requirements for extracurricular German Language Certificate:

- Participation
  - each registered semester in class of at least 80% (attendance card will be issued); Participants are responsible for making up for any missed classes in cooperation with the lecturer
- German Level
  - Minimum level to be tested is B1
  - Improvement of German skills by at least one stage (A2 – B1; B1 – B2 etc.) referring to the German allotment test offered by GPE.
- Pre-Test
  - Presentation and written homework
  - Students reach at least the grade level good

Costs for separate certificate
Fee for one separate German Exam will be covered by GPE. GPE reserves the right to charge exam fee for missing an exam.

9. Duration of Module

The courses are available for first to third semester students only.

10. Number of Participants

Each course has a limited number of maximum 20 participants. Additional courses might be offered upon request.

11. Inscription Formalities

Including this module to transcript or final record is excluded.
Registration dates and deadlines will be announced approx. 2 weeks after placement test.
Once registered to a class, the registration is binding and has contractual character.

Module Title: Sustainability - Approaches and Tools	**CP (ECTS):** 6	**Acronym:** SAT	**Module Group:** Intercultural Communication
Responsible for Module: Dr.-Ing. Elisabeth Strecker	**Secretary:** Z1	**E - mail:** e.strecker@tu-berlin.de	

Module Description

1. Qualification Goals

Students have

- knowledge of the present sustainability idea (Triple Bottom Line), its origin and development as well as new approaches
- an understanding of the inter- and intragenerational dimensions of sustainability, mainly represented by natural resource use and international balance problems.
- applicable knowledge of approaches and tools for sustainable development in society, business and private field
- mastery of up to date tools for sustainability analysis and management
- the motivation to implement tools in their professional and private life
- the ability to stay informed on important sustainability topics

The module imparts predominantly the following competence:

Technical 10%	Methodical 30%	Systemic 30%	Social 30%

2. Contents

The course looks at sustainability from the perspectives of nature, history/science, management, policy and private life. The focus is company sustainability / Corporate Social Responsibility n industry.
Shortly, the natural factors of a sustainable development are introduced. The students then gain knowledge about history and development of the sustainability idea and its implementation in business, policy and private life. The integration of environmental and social aspects into these fields (or implementing the three dimensions in balance) based on intercultural specifics is the lecture core. All topics will be dealt with from an international view, as sustainability includes intra-generational equity and globalization inserts strongest impacts on countries' development. Examples for sustainability efforts shall encourage own action. Information sources for all topics help to follow important developments.

3. Literature and Script

Sources:

- World Commission on Environment and Development: Report of the World Commission on Environment and Development: Our Common Future (Brundtland report), 1987
- United Nations: Agenda 21. Final document of UN Conference on Environment and Development (UNCED) Rio de Janeiro, Brazil, 1992
- Global Reporting Initiative (GRI) G4 Guidelines
- ISO 26000 Social responsibility

More sources with the respective topics

4. Module Courses

Course Title	Type	SWH	CP	P/W/WP	WS/SS
Sustainability - Approaches and tools Group 1	IV	4	6	P	SS
Sustainability - Approaches and tools Group 2	IV	4	6	P	WS

Course Title	Lecturer	Language
Sustainability - Approaches and tools Group 1	Dr.-Ing. E. Strecker	English
Sustainability - Approaches and tools Group 2	Dr.-Ing. E. Strecker	English

5. Description of Teaching Mode

Lecture, case studies, training / team work, discussion, students' presentations, field trips

6. Condition for Participation

Module Title: Sustainability - Approaches and Tools	**CP (ECTS):** 6	**Acronym:** SAT	**Module Group**: Intercultural Communication
Mandatory: None Preferable: Industry knowledge			

7. Teaching and learning activities (Effort and Credit Points)

60 hours contact, 60 hours preparation of presentation, 60 hours preparation of a home work as final examination.
Total: 180 hours = 6 CP (30 hours = 1 CP).

8. Assessment criteria (Examination and Grades)

Examination:
Portfolio Examination according to examination regulations, Section 12.
Grading:
Presentation in group 30%, Portfolio Examination 70%

9. Duration of Module

The module can be performed within one semester.

10. Number of Participants

Group 2 will only be offered upon request and depends on the number of students applied for the course
The number of each class is limited to a maximum of 25 participants.

11. Inscription Formalities

Registration at the GPE-Student office according to the GPE study and examination regulations.
Dates and deadlines will be announced by semester start.

Module Title: *International and Intercultural Project Management*	**CP (ECTS):** 6	**Acronym:** IIPM	**Module Group:** Intercultural Communication
Responsible for Module: Dr. Wolfgang Glitscher	**Secretary:** GPE	**E - mail:** dreip-consult@outlook.com	

Module Description

1. Qualification Goals

Students know how to manage international projects and programs, located in multiple cultural regions. They are enabled to work productively in intercultural teams and know about criteria for the composition of international teams. Project control with respect to criteria such as collaboration between partners in different time zones is trained. Students are prepared for the self-depended organization of projects with an international and intercultural background. Students are acquainted with the requirements and solutions for existing and emerging IT tools for managing international projects. In order to anticipate possible drawbacks in managing projects, students are familiar with methods and tools on how to avoid typical mistakes. They understand that different cultures and different people might have various views and expectations on the project goals. Students know about the important role of the project manager in international teams and how to communicate and cooperate successfully.

The module imparts predominantly the following competence:

Technical 25%	Methodical 25%	Systemic 20%	Social 30%

2. Contents

IIPM Magic Triangle, VUCA, SCARF, Social Infection Cyclus, Competencies, Team Building, Design Thinking, "Rapid" Design Thinking, Wicked Problems, Project Charter, System Thinking, Creating of WBS / RBS, Project Planning, Project Canvas, Value, Purple Space, Shared Project Room: Introduction to the software Redmine, Kick-Off Meeting, Action Learning: Reflection in Action, Principles of Observation, Critical PM Skillset, KanBan, SCRUM, Agile PM, Blue Ocean Leadership, Visual Process Management, Virtual Performance Assessment

3. Literature and Script

Literature

- „International Journal of Project Management": available within TUB-network at http://www.sciencedirect.com/science/journal/02637863
- Project Management: Best practices, Harald Kerzner (Editor), 3rd Edition, Wiley 2014
- Advanced Project Management: Best practices on Implementation, Harald Kerzner (Editor), Wiley 2004
- Levin, Ginger: Interpersonal Skills for Portfolio-, Program- and Project Managers, Management Concepts 2010
- Becker, Gora, Wagner: Erfolgreiches interkulturelles Perojektmanagement, symposion 2015

Details to further additional readings will be given in the courses.

Script for the content of the module is available and handed out to the students.

4. Module Courses

Course Title	Type	SWH	CP	P/W/WP	WS/SS
International and Intercultural Project Management Group 1	IV	4	6	P	SS
International and Intercultural Project Management Group 2	IV	4	6	P	WS

Course Title	Docent/Lecturer	Language
International and Intercultural Project Management Group 1	Dr. Wolfgang Glitscher	English
International and Intercultural Project Management Group 2	Dr. Wolfgang Glitscher	English

5. Description of Teaching Mode

Explorative, situational and problem-oriented teaching methods will be used to provide knowledge and skills about international and intercultural project management. Organizational as well as methodical contents will be taught. Lecturer mostly will set impulses to motivate the students to work on their own under supervision of the lecturer.

Students work on a case as a project during the lecture. Groups will be created randomly.

Module Title: *International and Intercultural Project Management*	**CP (ECTS):** 6	**Acronym:** IIPM	**Module Group**: Intercultural Communication
In the module, students are encouraged to practically simulate an international project. Individual experiences are discussed in class, aiming at identifying common challenges and solutions for international and intercultural project management. Concrete experiences of students are reinforced with theory.			

6. Condition for Participation

Mandatory: Basic knowledge in project management
Preferable: Module Project Management successfully completed

7. Teaching and learning activities (Effort and Credit Points)

Contact hours: project: 30 h, practical exercises: 30 h, course preparation and post-processing: 90 h,
Exam preparation: 30 h
Total: 180 hours = 6 CP (30 hours = 1 CP).

8. Assessment criteria (Examination and Grades)

Examination:
Portfolio examination
Prerequisites for admission to written test:
80% participation in lectures and seminar in order to be admitted to the final examination
Grading:
Presentation in group (5 min. → 5%)
Written test (60 min. → 50%)
Presentation of project in group (30 min. → 20%)
Seminar paper (25 %)

9. Duration of Module

The module can be completed within one semester.

10. Number of Participants

Group 2 will only be offered upon request and depends on the number of students applied for the course
The number of each class is limited to a maximum of 25 participants.

11. Inscription Formalities

Dates and deadlines for project, practical tasks and exam will be announced at the first lecture.
Registration at the GPE-Student office according to the GPE study and examination regulations.

Module Title: *Technology and Innovation Management*	**CP (ECTS):** 6	**Acronym:** TIM	**Module Group:** Intercultural Communication
Responsible for Module: Prof. Dr. Hendrik Send	**Secretary:** PTZ 306	**E - mail:** send@hiig.de	

Module Description

1. Qualification Goals

Technological innovation is becoming more important in a globalized world where a growing number of firms compete with increasing speed. At the same time, we observe a new open paradigm in innovation and collaboration and new methods to approach the innovation process and distributed collaboration. Furthermore, in order to propel innovation, it is important to select the right strategy, setting up appropriate organizational structures that support innovation, and managing the network of external collaboration partners.
The module, Technology and Innovation Management provides the students with basic knowledge and capabilities in systematic planning and management of innovation for organizations. Tools, methods and concepts of innovation management will be depicted, such as idea generation, selection methods, etc.

The module imparts predominantly the following competence:

Technical 25%	Methodical 25%	Systemic 25%	Social 25%

2. Contents

In Technology Management, the content is presented in the lectures and illustrated by some case studies. Several lectures contain an interactive part where the students will also directly apply their acquired knowledge to small tasks and present their results at the end of the lecture.
Innovation management will focus beyond the overall relevance of innovation for organizations, regardless of the organization's focus on production and service activities. The seminar will cover introduction to technological and innovation management, theoretical foundations of innovation management, local/regional/ national/global systems of innovation and the challenges of innovation management.

3. Literature and Script

Technology Management:

- Will be announced in the lecture

Innovation Management:

- Tidd, Joe 2009 Managing Innovation integrating Technological, Market and Organization Change.
- Trott, Paul 2005 Innovation management and new product development.
- Chesbrough, Henry 2003 Open innovation.

Printed and/or electronic scripts as announced in lectures.

4. Module Courses

Course Title	**Type**	**SWH**	**CP**	**P/W/WP**	**WS/SS**
Technology Management	SE	2	3	P	WS
Innovation Management	SE	2	3	P	WS

Course Title	**Docent/Lecturer**	**Language**
Technology Management	Prof. Dr.-Ing. Savas Tumis	English
Innovation Management	Prof. Dr. Hendrik Send/Matti Grosse M.Sc.	English

5. Description of Teaching Mode

The contents are presented in the lectures and illustrated by case studies. Several lectures contain an interactive part where the students will also directly apply their acquired knowledge to small tasks and present their results at the lecture's end.

6. Condition for Participation

Mandatory: None
Preferable: None

Module Title: *Technology and Innovation Management*	**CP (ECTS):** 6	**Acronym:** TIM	**Module Group:** Intercultural Communication

7. Teaching and learning activities (Effort and Credit Points)

60 hours contact, 60 hours post - processing and homework, 30 hours reading, 30 hours preparation for examination.
Total: 180 hours = 6 CP (30 hours = 1 CP).

8. Assessment criteria (Examination and Grades)

Examination:
Portfolio Examination according to examination regulations, Section 12.
Prerequisites for admission to oral/written examination:
None.
Grading:
50% Technology Management, 50% Innovation Management.

9. Duration of Module

The module can be performed within one semester.

10. Number of Participants

The number of this course is limited to a maximum of 30 participants.

11. Inscription Formalities

Prerequisite to registration is the participation in the Workshop Intercultural Communication and Relationships
Upon presentation of the certificate of attendance of WICR registration at the GPE-Student office according to the GPE study and examination regulations.
Dates and deadlines will be announced by semester start.

E Module Group Special Profile

Module Title: *GPE Seminar – Scientific Working*	**CP (ECTS):** 0	**Acronym:** GPE SFW	**Module Group**: Special Profile
Responsible for Module: Justin Davies, Ph.D.	**Secretary:** PTZ 2	**E - mail:** davies@posteo.de	

Module Description

1. Qualification Goals

Engineering Innovation is the root to global wealth and welfare. Innovation occurs, when engineers work together on solving problems and applying new technologies in technological systems und economical, ecological and social restrictions. Scientific work is the basis for efficient task fullfilment and innovation creation. Young students have to be enabled to conceive, design, implement, operate real-world systems and new products and processes. This teaching module deals with the fundamentals and methods of working in the forefront of innovation on a current research topic given by university. Students will be empowered to analyse given problems, solving tasks within a given timeframe and work out a scientific report to the current reseach topic. They will be enabled to plan the fulfilment of complex tasks within a group of people with different knowlede, skills and interests. They will acquire the competence to work successfully on any further scientific work like their master thesis or a P.h.D. topic or within a researcher group in the R&D field.

The module imparts predominantly the following competence:

Technical 30%	Methodical 20%	Systemic 30%	Social 20%

2. Contents

This seminar held as a project oriented course is giving the class one main topic, with several sub topics. The students plan how to divert the scientific problem in several sub topics. The group plans and determines milestones and deliverables, each student takes over a specified working area within the scientific task where he has to work on within the group.

The contents are out of the areas production technology, international management, information and communication technology and engineering education. Students have to execute all tasks nessecary to do independend scientific work on a given question, like analyzing the state of the art by gathering information and resources, form hypothesis, perform experiment, collect, analyze and interpret data, draw conclusions, publish results by presenting and writing papers.

Students train to work successfully with methods and tools for successful research, learning and teaching.

Contents are presented in a kick-off meeting. After that students have to independently organize their tasks. Process steps within their project are to learn:

- How to gather information and to quote
- How to work in groups
- How to write reports
- How to present academic results in power point presentation (Information provision, motivating the auditory, visual and verbal information)
- How to combine different research results to come up with a new model, concept, theory
- How to write scientific articles / term papers and master theses (form, content, structure)

3. Literature, Script

Literature, as announced in lectures according to respective subjects.

4. Module Courses

Course Title	Type	SWH	CP	P/W/WP	WS/SS
GPE Seminar- Scientific Working I	SE	1	0	P	WS
GPE Seminar- Scientific Working II	SE	1	0	P	WS

Course Title	Docent/Lecturer	Language
GPE Seminar – Scientific Working I	Justin Davies; Ph.D.	English
GPE Seminar – Scientific Working II	Justin Davies; Ph.D.	English

5. Description of Teaching Mode

Basics are presented in lectures, group discussions take place

Module Title: *GPE Seminar – Scientific Working*	**CP (ECTS):** 0	**Acronym:** GPE SFW	**Module Group**: Special Profile

6. Condition for Participation

Mandatory: None
Preferable: None

7. Teaching and learning activities (Effort and Credit Points)

10 hours contact, 20 hours post processing and homework, 35 hours reading/researching, 75 hours working on the scientific essay

8. Assessment criteria (Examination and Grades)

Examination:
Portfolio Examination according to examination regulations, Section 12.
Prerequisites for admission to oral/written examination:
Participation in the mandatory seminars.
Grading:
No quantity grade is given; either “pass” or “fail”

9. Duration of Module

The module can be performed within one semester.

10. Number of Participants

The number of partcipants in this course is unlimited.

11. Inscription Formalities

Mandatory course – no registration required.
Attending and passing this course is a requirement for the Master Thesis Registration!
A master thesis can only be registered upon passing this course.

Module Title: Methods-Time Measurement	**CP (ECTS):** 6	**Acronym:** MTM	**Module Group:** Special Profile
Responsible for Module: Prof. Dr.-Ing. Günther Seliger	**Secretary:** PTZ 2	**E – mail:** seliger@mf.tu-berlin.de	

Module Description

1. Qualification Goals

The participants have an overview over the method for the evaluation and the continuous improvement of current and new work systems and production processes. At the end of the course, the participants are able to use the methods and their rules, as well as describing and conceiving manual work places on the basis of the MTM-1 and MTM Universal Analysis Systems (UAS). Additionally, it is intended for the participants to be able to divide a work sequence in repeatable cycles, both in individual or group work. The two-week MTM-1 and MTM-UAS training seminar provides participants with theory of the MTM Basic System as a prerequisite for using it in practice in the project.

The module imparts predominantly the following competence:

Technical 25%	Methodical 35%	Systemic 35%	Social 5%

2. Contents

- Development and structure of the MTM Process
- Historical development of the study of movement and systems with predetermined times
- The development of MTM: goals, approaches (initial data, LMS, statistics, validation), research
- Definitions: Time measuring units, symbols, standard time cards
- Summary of the complete MTM Process building block system: aggregation and hierarchy levels, method levels, application areas, use and limits
- Practical work with the MTM 1 and UAS Systems
- Basic motions: reach, grasp, move, position, release ; press, turn, separate ; visual functions ; physical movements
- Actual activity and planning analysis
- Case studies and exercises according to ergonomic and business criteria

3. Literature and Script

Printed scripts are provided in the lectures.

4. Module Courses

Course Title	Type	SWH	CP	P/W/WP	WS/SS
Methods-Time Measurement Seminar	SE	2	3	P	SS
Methods-Time Measurement Project	PJ	2	3	P	WS

Course Title	Instructor/Lecturer	Language
Methods-Time Measurement Seminar	Jan Philipp Menn, M.Sc.	English
Methods-Time Measurement Project	Jan Philipp Menn, M.Sc.	English

5. Description of Teaching Mode

The course is given by an instructor, certified by the German MTM Association, using certified presentation material. MTM-1 and -UAS part will be taught in a two-week block seminar. The students will be given the opportunity to apply individually or in group work theoretical concepts with concrete exercises, that will be corrected in class. Examples of improvement of workplaces will be discussed. At the end of the theoretical teaching, videos will be analyzed and their results discussed. The practical application project will allow students to suggest their own measures for workplace improvement, based on a practical industry case. According to the availability of the laboratory, students will be given the possibility to observe manual workplaces. According to the availability of the laboratory, students will be given the possibility to observe manual workplaces

6. Condition for Participation

Mandatory: Seminar: none, Project: passing the MTM-UAS test with at least 50%
Preferable: mechanical engineering, industrial engineering, quality management, business administration.

Module Title:	**CP (ECTS):**	**Acronym:**	**Module Group:**
Methods-Time Measurement	6	MTM	Special Profile

7. Teaching and learning activities (Effort and Credit Points)

MTM-1 and MTM-UAS basic seminar: Takes place over two full weeks: 80h contact, 20h preparation, 20h post processing and homework
Practical application project: Takes place as group work over approximately two months. Two interim presentations with the MTM instructor will be mandatory for the students to present the evolution of their work: 6h contact, 24h preparation of meetings and final report, 30h group work.
Total: 180 hours = 6 CP (30 hours = 1CP).

8. Assessment criteria (Examination and Grades)

Examination
Portfolio Examination according to examination regulations, Section 12.
Grading:

- Written examination MTM-1: 50% of the final grade, consisting of:
  - Written examination MTM-1, video analysis, approx. 90 mins
  - Written examination MTM-1, multiple choice part 1, approx. 90 mins
  - Written examination MTM-1, multiple choice part 2, approx. 90 mins
- Written examination MTM-UAS: no grading, reaching at least 50% of the points is a prerequisite for access to the Project.
- Project work: 50% of the final grade, consisting of:
  - Interim presentation (in groups, 5 mins per student)
  - Final presentation (in groups, 5 mins per student)
  - Final report (about 10 pages per student**)**

Requirements to receive a MTM-Certificate from the MTM Association:
MTM-1: students reach 75% or more in the MTM-1 exam
MTM-UAS: students have an MTM-1 certificate and reach 75% or more in the MTM-UAS exam
Costs for separate certificate
GPE reserves the right to charge exam fee for missing an exam, in case additional costs are charged by the issuing association.

9. Duration of Module

Both MTM-1 and MTM-UAS basic seminars are given together in a two-week block course. The practical application project is a group work and lasts for about 2 months including 3 meetings with the instructor.
The module can be performed in two semesters.

10. Number of Participants

Limited to max. 25 participants.

11. Inscription Formalities

Registration at the GPE-Student office according to the GPE study and examination regulations.
Dates and deadlines will be announced by semester start.

Module Title: *Lean Management*	**CP (ECTS):** 6	**Acronym:** LM17	**Module Group**: Special Profile
Responsible for Module: Prof. Dr.-Ing. Holger Kohl	Secretary: GPE	**E - mail:** holger.kohl@tu-berlin.de	

Module Description

1. Qualification Goals

The objective of the Lean Management methodology is the elimination of waste to achieve highest quality, lowest costs and shortest lead times for delivering maximum value to the customer. By applying Lean methods significant improvements are feasible in any industry. The module Lean Management will provide an overview of principles, methods and tools for efficiently designing the entire value stream of industrial goods and services. Lean Management as it is taught in this module is a systematic and systemic approach that strives for a holistic production system and that goes beyond the selective application of Lean tools. The emphasis will be placed on the strategic aspect of Lean Management, also including the role of leadership during a Lean transformation of an organization, cultural issues, people involvement and change management topics. Besides practicing the application of basic Lean methods for production processes in factory environments, this course is also discussing the implementation of Lean methods for administration or engineering processes in office environments.

The module imparts predominantly the following competence:

Technical 10%	Methodical 40%	Systematical 40%	Social 10%

2. Contents

- History and definition of Lean Management: Elements of a Lean Production System, etc.
- Lean Management overarching principles: Pull & One Piece Flow, Waste reduction, Zero defects, People link the system
- Methods and tools to implement Lean Management: 5S, Value Stream Analysis and Improvement, 3P (Production Preparation Process), Lean Implementation Workshop, Standard Operations, Set-Up reduction (SMED), WIP-Limit-Method, 6Sigma, Lean Accounting, etc.

3. Literature and Script

Printed and/or electronic scripts as announced in lectures.

4. Module Courses

Course Title	Type	SWH	CP	P/W/WP	WS/SS
Lean Management Group 1	IV	4	6	P	SS
Lean Management Group 2	IV	4	6	P	WS

Course Title	Docent/Lecturer	Language
Lean Management Group 1	Dipl.Kfm. Johannes Fischer	English
Lean Management Group 2	Dipl.Kfm. Johannes Fischer	English

5. Description of Teaching Mode

Method of Instruction

The class is designed to be based on active involvement and discussion. Thorough preparation is expected.

Assignments/ Deliverables and class preparation

- Each student will give a presentation about a Lean Management topic including a handout for the class.
- Homework assignment consists of reading technical literature, answering previously announced questions and getting prepared for discussion in class.

6. Condition for Participation

None

7. Teaching and learning activities (Effort and Credit Points)

60 hours contact, 60 hours post processing and homework, 60 hours preparation for examination
Total: 180 hours = 6 CP (30 hours = 1 CP).

Module Title: *Lean Management*	**CP (ECTS):** 6	**Acronym:** LM17	**Module Group**: Special Profile

8. Assessment criteria (Examination and Grades)

Examination:
Portfolio Examination according to examination regulations, Section 12.
Prerequisites for admission to oral/written examination:
None.
Grading:
20% Homework, 40% Presentation, 40% Exam.

9. Duration of Module

The module can be performed in one semester.

10. Number of Participants

Group 2 will only be offered upon request and depends on the number of students applied for the module
The number of each class is limited to a maximum of 15 participants.

11. Inscription Formalities

Registration at the GPE-Student office according to the GPE study and examination regulations.
Dates and deadlines will be announced by semester start.
Presentation assignment groups will be determined in the first lecture.
Students registering this module cannot register Lean Production.

Module Title: *Lean Production*	**CP (ECTS):** 6	**Acronym:** LP17	**Module Group**: Special Profile
Responsible for Module: Dr.-Ing. Jens Palacios Neffke	**Secretary:** GPE	**E - mail:** jepane@yahoo.com	

Module Description

1. Qualification Goals

Upon successful completion of the course, participants will

- have the skills required to use Lean tools and data to decrease expenses, reduce cycle times, increase volume, and improve efficiency,
- hnow the methods and calculations required to determine resources, non-valued added activities in an operation, as well as the material/resources needed to deploy and support a Lean flow stream,
- he able to implement necessary Lean tools and methods in the shop floor under consideration of corporative & cultural challenges such as opposition to change.

The module imparts predominantly the following competence:

Technical 15%	Methodical 40%	Systematical 40%	Social 5%

2. Contents

In a time in which manufacturing companies are forced to deliver highest-quality products with the fewest defects, while reducing personnel and material resources, Lean production has become a very popular and effective method/philosophy to streamline production processes, improve quality, and cut costs in any industry. The course introduces core principles in Lean manufacturing such as continuous improvement, waste elimination, and pull-production philosophy. The course then focuses on the methods and tools commonly used to analyze and improve the existing state of a manufacturing environment, including value stream mapping, Kaizen cycle, single minute exchange of dies (SMED), and capability index. Illustrated with case studies, the course will demonstrate the efficiency and effectivity of successfully-implemented lean production approaches in global companies around the world.

History of lean; muda, mura, muri; Seven types of waste; Learning to see; Value Stream Mapping; Kaizen; SMED; Poka-Yoke; Autonomation and Jidoka; 5S; Standard work; Production levelling; work cell; Takt time; Andon; Genchi Genbutsu; Gemba; 5W and more

3. Literature, Script

- Roos, D.; Womack, J P., Jones, D.T (1991): The Machine That Changed the World: The Story of Lean Production, Harper Perennial.
- Womack, J. and Jones, D. (2003). Lean thinking: Banish waste and create wealth in your corporation. New York, USA: Free Press.
- Rother, M.; Shook, J.; Womack, J.; Jones, D. (2001): Learning to see: Value Stream Mapping to Add Value and Eliminate Muda. Massachusetts. U.S.: The Lean Enterprise Institute.
- Liker, J. (2004): The Toyota Way: 14 Management Principles from the World's greatest Manufacturer: McGraw-Hill corporation.
- Shingo, S. (1996): Quick Changeover for Operators: The SMED System. Portland U.S. Productivity Press
- Massaki, I. (1986): Kaizen: The key to Japan's competitive Success. Massachusetts, U.S. McGraw-Hill

4. Module Courses

Course Title	Type	SWH	CP	P/W/WP	WS/SS
Lean Production	IV	4	6	P	SS

Course Title	Docent/Lecturer	Language
Lean Production	Dr.-Ing. Jens Palacios Neffke	English

5. Description of Teaching Mode

Method of Instruction

The class is designed to be based on active involvement and discussion. Course participants will be provided with basic Lean concepts and methods, which are to be developed further by student teams throughout the semester.

Course Outline

Module Title:	**CP (ECTS):**	**Acronym:**	**Module Group**:
Lean Production	6	LP17	Special Profile

The kickoff is followed by a preparation phase. After the presentation and discussion of the concepts, the tools and methods will be trained. One tool or method will be applied in a group project. The course concludes with the presentation of the project results and their discussion.

6. Condition for Participation

Mandatory: None
Preferable: Participation in the module "Manufacturing and Factory Planning"

7. Teaching and learning activities (Effort and Credit Points)

Lecture and case studies: 60 hours contact, 60 hours post processing and homework, 60 hours preparation for examination
Total: 180 hours = 6 CP (30 hours = 1 CP).

8. Assessment criteria (Examination and Grades)

Examination:
Portfolio Examination according to examination regulations, Section 12.
Prerequisites for admission to oral/written examination:
None.
Assignments/ Deliverables and class preparation.
Course participants are provided with lean topics for them to present in class.
Student groups are built to implement lean tools in semester-long projects, specifically designed to test their lean understanding and implementation competences.
Grading:
Presentation 20%, Project conduction and report 30%, Final written examination 50% (60 min.)

9. Duration of Module

The module can be performed in one semester.

10. Number of Participants

The module is limited to 30 participants.

11. Inscription Formalities

Registration at the GPE-Student office according to the GPE study and examination regulations.
Dates and deadlines will be announced by semester start.
Students registering this module cannot register Lean Management.

Module Title: *Business Models and Entrepreneurship*	**CP (ECTS):** 6	**Acronym:** BME	**Major field**: Special Profile
Responsible for Module: Dr.-Ing. Ana Paula Barquet	**Secretary:** GPE	**E - mail:** anabarquet@gmail.com	

Module Description

1. Qualification Goals

The student learns about sustainable business models and business plans and how to design such models. The student learns the success factors of start-ups as well as tools required for international business development, international marketing and sales, market research and information management. The student is able to analyze existing business models and define own business models for startup companies. By end of the course, the student has developed an innovative business plan for international markets.

The module imparts predominantly the following competence:

Technical 25%	Methodical 40%	Systemic 25%	Social 10%

2. Contents

- Introduction: Business Canvas, business plan, startup, business finance
- Investors pitch: Stakeholder, partner and investor search, presentation styles
- Business Model: Dimensions, tools to design business models, Business model innovation (change, business units, start up, create new or modify current business model), examples
- Sustainable business model: Types of sustainable business models, examples
- Value Proposition and Customer Segment: Defining and understanding customer needs, value and benefits through products and services
- Resources, actors and processes: Intangible and tangible resources, types of partners, business processes (customer relationship, distribution channel, etc.), examples
- Costs and revenues: Types of costs and revenues (selling product, sharing, providing services, etc.), examples
- Analyzing existing business model
- Design of a sustainable business model
- Business Plan: Business plan framework for international start up's, business finance, examples
- International Business Development and Marketing: The International Marketing Concept & Marketing environment, strategic planning and marketing research, customer behavior, product strategy, pricing strategy, distribution strategy and retailing, promotional strategy, extending marketing competitive advantage, digital marketing, global dimensions of marketing and ethics, examples
- International Sales: technical sales skill sets, sales cycle (pre-sales, sales, after sales steps), sales strategies in international context, customer relationship management, negotiation skills, terms and condition in quotation/ contracts, business planning and forecasting, information management, examples

3. Literature and Script

Electronic scripts as announced in lectures.
Details to further additional readings will be given in the courses.

4. Module Courses

Course Title	**Type**	**SWH**	**CP**	**P/W/WP**	**WS/SS**
Sustainable Business Models and Entrepreneurship	IV	4	6	P	WS

Course Title	**Docent/Lecturer**	**Language**
Sustainable Business Models and Entrepreneurship	Dr.-Ing. Ana Paula Barquet, Dipl.-Ing. Markus Amendt	English

5. Description of Teaching Mode

Explorative, situational and problem-oriented teaching methods will be used to provide knowledge and skills about Sustainable Business Models and Entrepreneurship. Technical as well as methodical contents are taught. The course is designed in a highly interactive way. Existing business models are analyzed by students and presented in class. Students create innovative business models and business plans, guided by the lecturers.

Module Title: *Business Models and Entrepreneurship*	**CP (ECTS):** 6	**Acronym:** BME	**Major field**: Special Profile

6. Condition for Participation

Mandatory: -
Preferable: Manufacturing and Factory Planning, Global Production Management, Project Management

7. Teaching and learning activities (Effort and Credit Points)

64 hours contact, 96 hours course preparation and post-processing, 20 hours exam preparation
Total: 180 hours = 6 CP (30 hours = 1 CP).

8. Assessment criteria (Examination and Grades)

Examination:
Portfolio Examination according to examination regulations, Section 12.
Prerequisites for admission to written test:
80% participation in lectures and exercises
Grading:
50% written test (45 min.),
5% intermediate presentation about business model (in groups),
15% presentation: pitch about business plan (in groups),
30% documentation of business plan (in groups)

9. Duration of Module

The module can be completed within one semester.

10. Number of Participants

The course is limited to 30 participants.

11. Inscription Formalities

Registration at the GPE-Student office according to the GPE study and examination regulations.
Dates and deadlines for lecture, practical experience and exam will be announced at the beginning of each semester.

Module Title:	**CP (ECTS):**	**Acronym:**	**Major field:**
Resource Efficiency Strategies in industrial value chains	6	RES17	Special Profile
Responsible for Module:	**Secretary:**	**E - mail:**	
Prof. Dr.-Ing. Holger Kohl	PTZ 2	holger.kohl@tu-berlin.de	

Module Description

1. Qualification Goals

The people in the heavily industrialized regions of the world demand a high consumption of resources for their prosperity. People from newly emerging industrialized regions take the production and consumption of already industrialized countries as a model. With our current prevailing technologies and business models, which are based on the western lifestyle, the existent resources on earth are not enough for a way of life for everybody.
To ensure that future generations have adequate resources too, a change in the approach to resources is required. Therefore, new strategies to increase material efficiency in every stage of the value chain of all industrially manufactured goods are required.
At the end of the seminar, students

- are aware of the ressource shortages we might face in the future and its implications on higher prices on the feedstock market;
- get acquainted with the potentials to save ressources;
- see products and processes from their Life-cycle perspective and are able to assess, in which stage of the life cycle “low hanging fruits” saving ressources can be harvested;
- understand the relationships between different stakeholders in the value creation process. They gain a systemic understanding of mechanisms to improve the value creation network as a whole, and are able to solve contradictions like product individualization vs. remanufacturing standardization;
- are proficient in using several methods for mitigation of ressource consumption like: Design for X, Factory Analysis, Production on Demand, Remanufacturing, Identification of Yield Losses.

The module imparts predominantly the following competence:

Technical 30%	Methodical 30%	Systemic 30%	Social 10%

2. Contents

Lecture part on Ressource Efficiency

- Material efficiency strategies in product development: Modularity / platform strategy; Dematerialization of material products and services.
- Material efficiency strategies in production / remanufacturing: Product upgrades after the first life cycle; Reuse of components; Technical processes in remanufacturing; Technical processes in recycling; Logistical processes in recycling.
- Material efficiency strategies in the product use phase: Business models for longer life cycles, more intensive product and material usage, incentives for repair and resale; Technological solutions for longer life cycles, more intensive product and material usage, incentives for repair and resale.
- Material efficiency strategies from systems perspective of value creation: Potentials in value creation chains; Improvements over the whole life span of products.
- Legislative regulations: Take back ordinance, recycling quotas, ban of exports of end-of-life products.

Seminar: Ressource Efficiency Learning Game

- During the exercise/game students take on the role of E-scooter manufacturers and need to build, improve and maintain their value creation network by applying content from the lecture. Students need to:
  - Plan new manufacturing sites and improve them, e.g. by sustainable product design, implementation of Circular Economy for E-scooters and components, design of concepts for Product Service Systems with E-scooters in Berlin
  - Plan sales in different regions and for different markets
  - Plan how to deal with rising material prices as well as the environmental and social impact of their production

3. Literature and Script

- Seliger, G. (Editor), *Sustainability in Manufacturing - Recovery of Resources in Product and Material Cycles*, Springer Verlag, Berlin, Heidelberg 2007
- CIRP Annals, Life Cycle Management

Module Title:	**CP (ECTS):**	**Acronym:**	**Major field:**
Resource Efficiency Strategies in industrial value chains	6	RES17	Special Profile

- Herrmann, C.: Life-Cycle Management, Springer, 2009
- Julian M. Allwood, Michael F. Ashby, Timothy G. Gutowski, Ernst Worrell: Material efficiency: A white paper. In: Resources, Conservation and Recycling 55 (2011) 362–381, Elsevier, 2011

Further literature, will be announced in lectures according to respective subjects.

4. Module Courses

Course Title	Type	SWH	CP	P/W/WP	WS/SS
Resource Efficiency Strategies	IV	4	6	P	WS

Course Title	Docent/Lecturer	Language
Resource Efficiency Strategies	Johannes Seidel/Felix Sieckmann	English

5. Description of Teaching Mode

The module is organized in three block, each taking two days. Furthermore each day is divided into two parts with different teaching modes and styles:

- In the lecture Mr. Seidel presents contents and discusses them with students. Mainly teacher driven style
- In the seminar/game student groups plan and decide as managers of a company about various design, manufacturing, sales and recycling strategies. The game is supervised by Mr. Sieckmann. Mainly student driven style

Challenging tasks for respective master theses are continuously provided.

6. Condition for Participation

Mandatory: None
Preferable: Systematic Product Development, Manufacturing and Factory Planning, Environmental Management.

7. Teaching and learning activities (Effort and Credit Points)

Lectures: 26 hours contact, 16 hours post-processing, 18 hours reading, 30 hours preparation for examination.
Seminar/game: 26 hours contact, 34 hours presentation preparation, 10 hours group strategy making, 20 hours documentation.
Total: 180 hours = 6 CP (30 hours = 1 CP).

8. Assessment criteria (Examination and Grades)

Examination:
Portfolio Examination according to examination regulations, Section 12.
Prerequisites for admission to oral/written examination:
Successful participation in the seminar and the game.
Grading:
50% written test (60 min.), 20% presentation in groups, 30% game documentation in groups

9. Duration of Module

The module can be performed within one semester.

10. Number of Participants

The course is limited to 25 participants.

11. Inscription Formalities

Registration at the GPE-Student office according to the GPE study and examination regulations.
Dates and deadlines will be announced by semester start.
Resource efficiency game groups will be determined in the first meeting.

Module Title: *Simulation of Production Systems*	**CP (ECTS):** 6	**Acronym:** SPS	**Module Group:** Special Profile
Responsible for Module: Prof. Dr.-Ing G. Seliger	**Secretary:** PTZ 2	**E - mail:** seliger@mf.tu-berlin.de	

Module Description

1. Qualification Goals

The teaching module deals with the simulation as a method to analyze and evaluate the operation and design of manufacturing processes and facilities. Students are enabled to efficiently use the discrete event simulation technique for application in the production planning and control.
The following competences are gained:

- Ability to describe production systems by means of system engineering
- Overview in the field of discrete event simulation and state of the art of simulation packages
- Modeling and simulation with the simulation package Tecnomatix Plant Simulation
- Analysis and improvement of production systems with simulation
- Advantages and disadvantages of simulation

The module imparts predominantly the following competence:

Technical 20%	Methodical 40%	Systemic 20%	Social 20%

2. Contents

- Theory of discrete event simulation
- Object oriented modeling techniques
- Steps to conduct simulation studies and projects
- Classification of simulation packages
- Statistical analysis of simulation models
- Latest developments in the field of simulation, distributed simulation, web-based simulation, simulation and optimization, heuristics and algorithms for production control

3. Literature and Script

- Bangsow, Steffen: Manufacturing Simulation with Plant Simulation and Simtalk: Usage and Programming with Examples and Solutions. Springer-Verlag, Berlin Heidelberg, 2010
- Banks, Jerry: Simulation: Principles, Methodology, Advances, Applications and Practice. Whiley-Interscience, Atlanta, 1998
- Law, A. M.; Simulation Modeling and Analysis; McGraw-Hill, New York, NY; 5th ed. [international student edition] Edn., 2015

4. Module Courses

Course Title	Type	SWH	CP	P/W/WP	WS/SS
Simulation of Production Systems	IV	4	6	P	WS

Course Title	Docent/Lecturer	Language
Simulation of Production Systems	M.Sc. Bastian Müller	English

5. Description of Teaching Mode

In the integrated course, the students learn the basics of simulation in production systems and the application with the simulation package Tecnomatix Plant Simulation. In case studies, the ability to analyze simulation tasks and to handle simulation software is trained in several case studies.

6. Condition for Participation

Mandatory: none
Preferable: Manufacturing and factory planning

7. Teaching and learning activities (Effort and Credit Points)

60 hours contact, 30 hours homework, 90 hours project preparation and documentation
Total: 180 hours = 6 CP (30 hours = 1 CP).

Module Title:	**CP (ECTS):**	**Acronym:**	**Module Group:**
Simulation of Production Systems	6	SPS	Special Profile

8. Assessment criteria (Examination and Grades)

Examination:
Portfolio Examination according to examination regulations, Section 12.
Prerequisites for admission to oral/written examination:
None.
Grading:
Written test (30 min.) and case study presentation (90 min.) during class:

- 1/3rd of module grade - Written test
- 1/3rd of module grade - Presentation and Documentation of Case Study 1
- 1/3rd of module grade - Presentation and Documentation of Case Study 2

9. Duration of Module

The module can be performed within one semester.

10. Number of Participants

The number of this course is limited to a maximum of 24 participants

11. Inscription Formalities

Registration at the GPE-Student office according to the GPE study and examination regulations.
Dates and deadlines will be announced by semester start.

Module Title: *Enterprise Architecture and IT in the Automotive Industry*	**CP** (ECTS): 6	**Acronym:** EAAI	**Module Group**: Special Profile
Responsible for Module: Dr.-Ing. Dieter Schacher	**Secretary:**	**Email:** dieter.schacher@gmx.de	

Module Description

1. Qualification Goals

The major business drivers in the automotive industry are the vast globalization of markets with satisfied traditional markets and local competition especially in the emerging markets. Traditional European automotive companies have to improve existing products, create new products or enter new lines of business to remain competitive. There is a tremendous need for a transformation of automotive companies to enhance their efficiency and effectiveness based on market orientation, new disruptive technologies and value chain collaboration. This requires a holistic approach to design, manage and continuously improve the organization in global automotive companies.

The module imparts predominantly the following competence:

Technical 30%	Methodical 30%	Systemic 20%	Social 20%

2. Contents

This module will address the ongoing transformation of global automotive value chains, which requires organizational change and the purposeful use of information technology, and heavily relies on the involvement of the employees in transformation processes. Particular emphasis will be put on the interdependencies between strategy, business processes, organization and information technology (IT).

In the first part students will familiarize with the business processes of automotive firms and understand how changing business requirements force companies to continuously transform their organizational structure and IT landscape. In the second part students will investigate fundamental questions of information management in the automotive industry and learn how information systems support the core business processes. They will analyze the innovative use of information technology for the business, as well as for online service provisioning based on latest car IT innovations. Finally, students will learn the basic principles on systemic transformation management dealing with the necessary change in enterprise architecture, culture and behavior in the ongoing change in the global automotive industry.

The module uses interactive lectures based on the experience of the lecturer made within Volkswagen AG and his current consultancy work in the global automotive industry. The students will attend at an international conference on Enterprise Architecture Management (EAM) in Berlin and take a one-day field trip to Volkswagen plant in Wolfsburg for reflecting the topics of the module in today's business environment.

3. Literature, Script

Schacher, Dieter: *Informationssystemische Prozessorganisation mit sozioorientierter Transformation.* Fraunhofer IRB Verlag: Stuttgart 2007, ISBN 978-3-8167-7285-9
Becker, J.; Kugeler, M.; Rosemann, M.: *Process Management.* Springer-Verlag: Berlin et al., 2010 ISBN 978-3-642-07800-2
Ross, J. W., Weill, P., Robertson, D. C.: *Enterprise Architecture as Strategy.* Harvard Business School Press, Boston, 2006.
Printed and/or electronic scripts as announced in lectures.

4. Module Courses

Course Title	Type	SWH	CP	P/W/WP	WS/SS
Enterprise Architecture and IT in the Automotive Industry	VL	4	6	P	WS

Course Title	Docent/Lecturer	Language
Enterprise Architecture and IT in the Automotive Industry	Dr. Schacher	English

Module Title: *Enterprise Architecture and IT in the Automotive Industry*	**CP** (ECTS): 6	**Acronym:** EAAI	**Module Group**: Special Profile

5. Description of Teaching Mode

Contents are presented in lectures illustrated by case studies. The course is a mix of conventional classroom teaching and open discussion on management topics based on the industrial experiences in IT business and organization in automotive industry.

6. Condition for Participation

Mandatory: None
Preferable: Participation in the modules “Manufacturing and Factory Planning” and “Information and Communication Management”

7. Teaching and learning activities (Effort and Credit Points)

60 hours contact including 13 lectures (180 min) contact, 1-day conference on EAM (Enterprise Architecture Management), 1-day field trip to Volkswagen Wolfsburg, 60 hours post processing and homework, 60 hours preparation for examination

Total: 180 hours = 6 CP

8. Assessment criteria (Examination and Grades)

Examination:
Portfolio Examination according to examination regulations, Section 12.
Prerequisites for admission to oral/written examination:
None.
Grading:
180 Examination Points, thereof:
Class participation 60p, Executive summary (1 page) on EAM conference 30p, Executive summary (1 page) on Field trip 30p, Written Exam 60p

9. Duration of Module

The module can be performed within one semester.

10. Number of Participants

The number of this course is limited to a maximum of 20 participants.

11. Inscription Formalities

Registration at the GPE-Student office according to the GPE study and examination regulations.
Dates and deadlines will be announced by semester start.
Course for credits only.

Module Title: *Energy Entrepreneurship & Rural Electrification*	**CP (ECTS):** 6	**Acronym:** EERE	**Module Group:** Special Profile
Responsible for Module: Prof. Dr.-Ing George Tsatsaronis	**Secretary:** KT1	**E - mail:** tsatsaronis@iet.tu-berlin.de	

Module Description

1. Qualification Goals

The object of this course is for students to learn which means of energy supply can be instigated in a structurally underdeveloped region, as well as investigating what these interventions could mean for economic and social development. The focus lies on investigating technical possibilities, the energy infrastructure which already exists as well as one that should necessarily be put in place and the economical conditions of the region. Other aspects to be observed are the existing energy resources, the cultural and social structures as well as the political and administrative frameworks. Particular attention will be paid to what the use of renewable energy could mean in terms of sustainability. The goal of the project is not only to study the situation described, but also to investigate possibilities of transfering these technical and economical methodologies to other economally depressed regions where no energy supply exists, at the moment.
Therefore students gain competence in dealing with the valuating and analysing of markets, enterprises, technologies and financial tools in the renewable energy sector with the goal of learning to develop new kinds of ecological business and social entrepreneurship. Students will be enabled for developing own rudiments of a business plan and will additionally be qualified in project planning, market research and marketing.

The module imparts predominantly the following competence:

Technical 15%	Methodical 30%	Systemic 30%	Social 25%

2. Contents

The course concerns with the different energy sectors and decentralized and centralized energy supply on a world wide perspective. It includes electrification strategies, developing and manufacturing products for the microenergy sector. Additional topics are solar home systems, micro financing, business models and structures, business plan development, business financing, service models and marketing in rural areas.
New business options in the microenergy sector will be defined and developed referring to best practice and adapted concepts. Based on an short research phase, the potential of different energy markets will be analysed. At the end the participants get the opportunity to create their own draft of a business plan for energy supply based on adapted energy technologies.

3. Literature and Script

Yunus, M., *Banker to the Poor*, University Press LTd, Dhaka, 1998.

Printed and/or electronic scripts as announced in lectures.

4. Module Courses

Course Title	Type	SWH	CP	P/W/WP	WS/SS
Energy Entrepreneurship & Rural Electrification	VL	4	6	W	WS

Course Title	Lecturer	Language
Energy Entrepreneurship & Rural Electrification	Daniel Philipp, Dipl.-Ing.	English

5. Description of Teaching Mode

New contents are illustrated by the presentation of case studies and by excursions to industrial partners. In small teams, students will have to make a market research on the specific energy sector of their origin country and find out the appropriate technology and manufacturing possibilities. Based on their results, they will develop a business plan for their own energy enterprise.

6. Condition for Participation

Mandatory: none
Preferable: basic knowledge in business administration

Module Title: *Energy Entrepreneurship & Rural Electrification*	**CP (ECTS):** 6	**Acronym:** EERE	**Module Group:** Special Profile

7. Teaching and learning activities (Effort and Credit Points)

Project 60 hours contact, 55 hours post - processing and homework, 50 hours reading & internet research, 15 hours preparation for examination
Total: 180 hours = 6 CP (30 hours = 1 CP).

8. Assessment criteria (Examination and Grades)

Examination:
Portfolio Examination according to examination regulations, Section 12.
Prerequisites for admission to oral/written examination:
None.
Grading:
100% lecture.

9. Duration of Module

The module can be performed in one semester.

10. Number of Participants

The number of this course is limited to a maximum of 15 participants.

11. Inscription Formalities

Registration at the GPE-Student office according to the GPE study and examination regulations.
Dates and deadlines will be announced by semester start.

Module Title: *Hydro Power Technologies*	**CP (ECTS):** 6	**Acronym:** HPT	**Module Group:** Special Profile
Responsible for Module: Prof. Dr.-Ing. H. Kohl	**Secretary:** GPE	**E - mail:** thomas.pfeiffer@mastering-aid.de	

Module Description

1. Qualification Goals

Energy demands worldwide rise. Not only due to the growing population, but also due to larger proportions of the population able to participate in development, requirements for light, charging phones, cooking and artisanry grow. Lastly in the halfway urbanized global population, there is little alternative to cover energy demands with electricity. However, the limited and exhausted fossil energy carriers do not allow energy production to rely on them. Even more reason are the emissions threatening atmosphere and our habitats.

Among the emerging renewable energy sources, hydropower is the oldest way to provide energy. Electricity is produced from hydropower turbines over 130 years. Power water on a slope or from flows such as rivers and waves supply energy in a much more constant fashion, than photovoltaic's and wind power. This is particularly important in nets that depend increasingly on renewable energy. While in the past years, the abuse of river habitats has increasingly limited the thoughtless exploitation of water habitats, still it is a reliable source for power generation. Innovative solutions such as hydrodynamic generators will allow more sustainable solutions, where the creativity of engineers of tomorrow will be required.

This course offers and insight in the main components of hydropower, design, its application, construction as well as its economic aspects. The introduction will be methodogically systematic and of participatory nature. In this way, experiences of the participants will be involved, where they preexist. The objective of this 6 credit point course is:

The graduates gain a multidisciplinary overview in relevant fields of water damming, power generation/distribution and therefore have the necessary knowledge to deepen their insights and work particularly on smaller hydropower projects.

In order to achieve this goal, the course consists of lectures, experimental components and an excursion. A solid mathematical training is prerequisite.

The module imparts predominantly the following competence:

Technical 30%	Methodical 30%	Systemic 20%	Social 20%

2. Contents

- History of water mills and turbines, components and definitions
- Water cycle, Streams, oceans
- Principles and physics of power generation
- Dams, weirs, barrages
- Hydraulic Turbines (types, characteristics) and Hydraulic Pipes (leading to penstocks)
- Generators and power conversion
- Power transmission / distribution (Networks, Energy Sources)
- Power storage and power consumption
- Participation with clients and stakeholders, Market studies
- Rural and urban development
- Design of hydropower systems (Site selection)
- Construction, production and assembly
- Operation, maintenance and management
- Investment and Maintenance costs
- Financing and banking
- Environmental aspects of hydropower
- Responsibility of engineers and solutions through case studies
- Sustainability concepts / Environment protection
- Energy-Policies:
- Case studies, special case studies
- Experimental session hydropower dams

3. Literature and Script

Literature, as announced in lectures according to respective subjects.

Mosonyi E. (1987, 1991) Water Power development, Vol I, II, Akademiai Kmiado, Budapest

- Giesecke, J. und Mosonyi E. (2005). *Wasserkraftanlagen, Planung, Bau und Betrieb*. Berlin, D. Springer, 830 S.
- ASME – 1996 Guide to Hydropower Mechanical Design (Book) ASME, USA

Module Title:	CP (ECTS):	Acronym:	Module Group:
Hydro Power Technologies	6	HPT	Special Profile

- American Society of civil Engineers (ASCE) Civil Engineering guidelines for planning and designing hydroelectric developments. Volume 4; small scale hydro: New York 1989
- INHA -2005 Hand Book on Operation and Maintenance of Hydropower Stations United States Bureau of Reclamation, USA
- VGB: Investment and Operation Cost Figures - Generation Portfolio, Essen, December 2011
- Gagnon L.: Comparing environmental impacts of power generation options; evaluations of hydro Quebec, Canada for IEA, 2000

Printed and/or electronic scripts as announced in lectures.

4. Module Courses

Course Title	Type	SWH	CP	P/W/WP	WS/SS
Hydro Power Technologies	IV	4	6	P	WS

Course Title	Lecturer	Language
Hydro Power Technologies	Dipl.-Ing. Thomas Pfeiffer	English

5. Description of Teaching Mode

The lectures will present hydropower to the students in a systematic fashion. Along the components, the course will present the theoretical background in physics and the engineering aspects methodologically.

After the familiarization with the technical components, the students will obtain an insight in policies, environmental aspects and their mitigation and management. Finally, to practically demonstrate hydropower, experiments and excursions will round up the program.

6. Condition for Participation

Mandatory: None
Preferable: None

7. Teaching and learning activities (Effort and Credit Points)

Integrated Course: 52 hours contact, 52 hours post-processing and homework, 26 hours reading, 50 hours preparation for examination

Total: 180 hours = 6 CP (30 hours = 1 CP).

8. Assessment criteria (Examination and Grades)

Examination:
Portfolio Examination according to examination regulations, Section 12.
Prerequisites for admission to oral/written examination:
Passing all exercises.
Grading:
Grading will be presented during the first lecture

9. Duration of Module

The module can be performed in one semester.

10. Number of Participants

Lectures are limited to 20 participants.

11. Inscription Formalities

Registration at the GPE-Student office according to the GPE study and examination regulations.
Dates and deadlines will be announced by semester start.
Exercise groups will be determined in the first lecture.

F Extra Curricular Modules

The following modules are not part of the regular GPE course curriculum and will not be adjusted to the GPE semester schedule. They are marked with a "TUB" before the acronym in the module description, list and overview.

These modules are regularly offered by other TUB institutes and they might be of interest for some GPE students.

GPE students are welcome to enroll in these modules and register them according to the GPE registration and examination regulations.

Module Title:	**CP (ECTS):**	**Acronym:**	**Module Group:**
Energy Engineering	12	TUB-EE	Engineering
Responsible for Module:	**Secretary:**	**E - mail:**	
Prof. Dr.-Ing. Tetyana Morozyuk	KT1	tetyana.morozyuk@tu-berlin.de	

Module Description

1. Qualification Goals

With the worldwide increasing energy requirements and the decreasing supply of fossil energy sources, the environmental awareness of people rises. Energy technologies gain more and more importance. The task of energy engineering is to provide energy in the required form constantly (electrical energy, driving energy, etc.) and to ensure an optimal compromise between resource saving (fuel, raw material, etc.) and reduction of environmental pollution (exhaust fumes, noise, etc.) as much as possible. The greatest attention is paid to the thermal energy conversion. The internal combustion engine and the gas turbine will be analysed as they are used for driving all kinds of vehicles. Moreover, the gas turbine, as well as the steam turbine is treated because of their importance for producing electricity.
Fundamentals of energy technologies, principles of operation of the related machines and the awareness of the corresponding economic background will be passed on to students – a must for all engineers. Practice with real energy converters completes the lectures.
The goal of the module is to familiarize students with (a) modern methods of analysis and evaluation of thermal systems, and (b) principles from the operation and design of the most commonly used energy conversion devices. In the laboratory students become familiar with the operation and evaluation of internal combustion engines and gas turbines.

The module imparts predominantly the following competence:

Technical 30%	Methodical 30%	Systemic 20%	Social 20%

2. Contents

Energy Engineering I builds the fundamentals for the more exhaustive energy systems' analysis of Energy Engineering II. The emphasis in this semester is assuring students have the necessary thermodynamic and economic knowledge for advanced study, and achieving comfort with the Second Law of Thermodynamics.
In Energy Engineering II, the fundamentals covered in Energy Engineering I are applied to entire systems. Engineering economics is applied to the calculation of product costs. Students learn to identify the inefficiencies of energy conversion systems. With the identification of the inefficiencies, better understanding of the various improvements made to real systems is attainable.

Energy Engineering I (4 SWH)

- Supply and prices of energy carriers
- Energy resources and prices
- Thermodynamic analysis
- Economic analysis
- Energy conversion equipment
- Exergy analysis
- Fundamentals of combustion

Energy Engineering II (4 SWH

- Calcualtion of product costs
- Fuel cells
- Steam power plants
- Gas turbines and gas - turbine based processes
- Other processes for electricity generation
- Cogeneration plants
- Combined cycle power plants
- Heat pumps and refrigeration systems
- Rational use of energy

Systems using renewable energy

3. Literature and Script

Literature: Bejan, G. Tsatsaronis and M. Moran, A. Wiley, *Thermal Design and Optimization*, 1996.
Printed and/or electronic scripts as announced in lectures.

4. Module Courses

Course Title	**Type**	**SWH**	**CP**	**P/W/WP**	**WS/SS**
Energy Engineering I	VL	2	3	P	WS
Energy Engineering Exercises I	UE	2	3	P	WS
Energy Engineering II	VL	2	3	P	SS
Energy Engineering Exercises II	UE	2	3	P	SS

Module Title: *Energy Engineering*	**CP (ECTS):** 12	**Acronym:** TUB-EE	**Module Group:** Engineering

Course Title	Docent/Lecturer	Language
Energy Engineering I	Prof. Dr.-Ing Tetyana Morozyuk	English
Energy Engineering Exercises I	Prof. Dr.-Ing Tetyana Morozyuk	English
Energy Engineering II	Prof. Dr.-Ing Tetyana Morozyuk	English
Energy Engineering Exercises II	Prof. Dr.-Ing Tetyana Morozyuk	English

5. Description of Teaching Mode

Contents are presented in lectures illustrated by small exercises and case studies.

6. Condition for Participation

Mandatory: Basic knowledge of thermodynamics.
Preferable: None

7. Teaching and learning activities (Effort and Credit Points)

Lectures: 60 hours contact, 45 hours post - processing and homework, 45 hours reading, 30 hours preparation for examination
Exercises: 60 hours contact, 45 hours preparation, 45 hours documentation, 30 hours preparation for examination
Total: 360 hours = 12 CP (30 hours = 1 CP).

8. Assessment criteria (Examination and Grades)

Examination:
Portfolio Examination according to examination regulations, Section 12.
Prerequisites for admission to oral/written examination:
None.
Grading:
100% exercise.

9. Duration of Module

The module can be performed within two semesters.

10. Number of Participants

Lectures are unlimited. Exercises are limited according to the requirements of the laboratory.

11. Inscription Formalities

Registration at the GPE-Student office according to the GPE study and examination regulations.
Dates and deadlines will be announced by semester start.
Exercise groups will be determined in the first lecture.

Module Title: *Stationary Energy Storage Technologies*	**CP (ECTS):** 6	**Acronym:** TUB-SEST	**Module Group**: Special Profile
Responsible for Module: Prof. Dr.-Ing. Julia Kowal	**Secretary:** EMH2	**E - mail:** Julia.kowal@tu-berlin.de	

Module Description

1. Qualification Goals

After completing the module, the students are able to compare electrical and electrochemical energy storage systems and to choose a suitable technology for a given application.

The module imparts predominantly the following competence:

Technical 20 %	Methodical 40 %	Systemic 30 %	Social 10 %

2. Content

Different energy storage systems are regarded concerning their electrical characteristics and suitability for different applications with main focus on stationary systems. Their working principle and ageing mechanisms are presented in reduced complexity.
Covered technologies:
capacitors, coils, flywheels, pumped hydro storage, compressed air, non-rechargeable batteries, lead-acid batteries, lithium batteries, NiMH, NiCd, high temperature batteries, redox-flow batteries, metal-air batteries, thermal energy storage

3. Literature and Script

Literature: As announced in lectures and exercises according to respective subjects.
Script: Lecture slides and videos of lectures are available for download.

4. Module Courses

Course Title	Type	LSW	CP	P/W/WP	WS/SS
Stationary Energy Storage Technologies Lecture	VL	2	3	P	SS
Stationary Energy Storage Technologies Exercise	UE	2	3	P	SS

Course Title	Docent/Lecturer	Language
Stationary Energy Storage Technologies Lecture	Prof. Dr.-Ing. Julia Kowal	English
Stationary Energy Storage Technologies Exercise	Prof. Dr.-Ing. Julia Kowal	English

5. Description of Teaching Mode

The course consists of lecture and exercise. In the lectures, the different technologies, their characteristics and applications are introduced and the exercises consist of repetition, extension, more examples and calculations.

6. Condition for Participation

Mandatory: None
Preferable: Basic knowledge in physics, chemistry and electrical circuits

7. Teaching and learning activities (Effort and Credit Points)

Lecture: 30 hours contact, 45 hours post-processing, 15 hours preparation for exam
Exercise: 30 hours contact, 45 hours post-processing, 15 hours preparation for exam
Total: 180 h = 6 CP (30 hours = 1 CP)

8. Assessment criteria (Examination and Grades)

Oral exam

9. Duration of Module

The module can be performed in one semester.

10. Number of Participants

The number of participants is limited to 50 participants.

Module Title:	**CP (ECTS):**	**Acronym:**	**Module Group**:
Stationary Energy Storage Technologies	6	TUB-SEST	Special Profile

11. Inscription Formalities
Registration at the GPE-Student office according to the GPE study and examination regulations. Dates and deadlines will be announced in the first lecture of each semester. Attendance of the first lecture is mandatory for enrollment. Later registration cannot be accepted.

G GPE– Glossary

[1] *VL – Lecture (credits only):*
In lectures, the matter specified in the curriculum will be presented by the university teacher in the form of regular lectures. The lecturer, usually a professor, gives presentations and imparts theoretical technical knowledge. Group size can vary widely and students participate through listening and asking questions.

UE – Exercise (credits only):
Knowledge from lectures is shaped out and detailed by analytical, design, or experimental examples supervised by an assistant. Medium-size groups of students learn to solve problems by working on example tasks and case studies.

IV – Integrated Course (credits only):
Various instruction forms take turns in one course without clear methodological distinction.

SE – Seminar (credits only):
Small or medium-size groups of students will learn to work self-dependently on selected topics with supervision of a professor or assistant. Discussions, presentations or written papers may be applied.

PJ – Project (credits only):
Projects involve carrying out a planning and realisation proves in a cooperative form of work.

[2] *SWH: Lecture Hours per semester week*
(4 SWH is four hours a week in one semester OR two hours a week in two semesters. Exercises require equivalent time additionally).

[3] *CP – ECTS:*
Credit point according to the European Credit Transfer System

[4] *P/W/WP:*
(P) Pflicht = compulsory; (W)Wahl = elective; (WP) Wahlpflicht = compulsory option; Meaning: by choosing the module the corresponding courses are mostly compulsory;

[5] *Number of Participants*
Generally, courses will only be conducted provided that a minimum of 5 credit participants is reached. Exceptions are mentioned in the module description.

Seats in courses with a limited number of participants are allotted according to the date of the online enrollment – always on a "first come first served" basis.

[6] *Module Examinations*
..are conducted in the following ways: as a thesis (Article 46) and standard module exams alongside the course in the form of an oral exam (Article 43), written exam or Portfolio Examination

An oral exam
..is carried out by at least one examiner in the presence of an observer. Exams may be conduct-ed in groups or as individual exams and last from 20 to 60 minutes. The result counted 100% for the complete module.

A written exam
The duration of a written exam amounts to at least 90 minutes and no more than four hours. Multiple choice questions and electronic examination procedures are permitted as written exams. The result counted 100% for the complete module.

The portfolio examination
..constitutes a standard type of exam, in which students can continuously provide different types of specific results within the teaching units of a module. It consists of several different types of exam elements alongside studies. Special consideration is given here to the written composition, multiple-choice test, seminar paper, recorded practical assignment, outline, creative work, consultation or poster. Up to three written tests may be required within the portfolio examination.