JACOBS UNIVERSITY

Study Program Handbook

# Industrial Engineering & Management

Bachelor of Science

Subject-specific Examination Regulations for Industrial Engineering & Management (Fachspezifische Prüfungsordnung)

The subject-specific examination regulations for Industrial Engineering & Management are defined by this program handbook and are valid only in combination with the General Examination Regulations for Undergraduate degree programs (General Examination Regulations = Rahmenprüfungsordnung). This handbook also contains the program-specific Study and Examination Plan (Chapter 6).

Upon graduation, students in this program will receive a Bachelor of Science (BSc) degree with a scope of 180 ECTS (for specifics see Chapter 6 of this handbook).

| Version | Valid as of | Decision | Details |
|---|---|---|---|
| Fall 2019 – V1.2 | Sep 01, 2019 | Approved by the Academic Senate on August 28, 2019. | V1 Master version<br>V1.1 Editorial changes, indicative literature added, change of semester sequence of CHOICE modules<br>V1.2 Error correction |

# Contents

# 1 Program Overview

## 1.1 Concept

### 1.1.1 The Jacobs University Educational Concept

Jacobs University aims to educate students for both an academic and a professional career by emphasizing four core objectives: academic quality, self-development/personal growth, internationality and the ability to succeed in the working world (employability). Hence, study programs at Jacobs University offer a comprehensive, structured approach to prepare students for graduate education as well as career success by combining disciplinary depth and interdisciplinary breadth with supplemental skills education and extra-curricular elements.

In this context, it is Jacobs University's aim to educate talented young people from all over the world, regardless of nationality, religion, and material circumstances, to become citizens of the world who are able to take responsible roles for the democratic, peaceful, and sustainable development of the societies in which they live. This is achieved through a high-quality teaching as well as manageable study loads and supportive study conditions. Study programs and related study abroad programs convey academic knowledge as well as the ability to interact positively with other individuals and groups in culturally diverse environments. The ability to succeed in the working world is a core objective for all study programs at Jacobs University, both in terms of actual disciplinary subject matter and also to the social skills and intercultural competence. Study-program-specific modules and additional specializations provide the necessary depth, interdisciplinary offerings and the minor option provide breadth while the university-wide general foundation and methods modules, mandatory German language requirements, and an extended internship period strengthen the employability of students. The concept of living and learning together on an international campus with many cultural and social activities supplements students' education. In addition, Jacobs University offers professional advising and counseling.

Jacobs University's educational concept is highly regarded both nationally and internationally. While the university has consistently achieved top marks over the last decade in Germany's most comprehensive and detailed university ranking by the Center for Higher Education (CHE), it has also been listed by the renowned Times Higher Education (THE) magazine as one of the top 300 universities worldwide in 2018. The THE ranking is considered as one of the most widely observed university rankings. It is based on five major indicators: research, teaching, research impact, international orientation, and the volume of research income from industry.

### 1.1.2 Program Concept

Industrial engineering is one of the most versatile and flexible branches of engineering. It has been said that engineers make things, whereas industrial engineers make things better. Industrial Engineering deals with both the creation and the management of systems that integrate people, materials and energy in productive ways.

The BSc Industrial Engineering & Management (IEM) covers topics such as process engineering, operations research, supply chain management, engineering design, logistics, and project management.. During their studies at Jacobs University, students are equipped with the essentials of business functions from both an engineering and management perspective and are

thus prepared for successful careers in the industry. They learn to optimize processes and resources as well as to manage international firms and projects.

In an ever-changing and developing world, industrial engineering is essential for modern societies as it helps to design sustainable systems. IEM students at Jacobs University learn how to adapt to the new digital technologies and trends that businesses are adopting as well as the global challenges society is facing.

The IEM program is of special interest to those who:

- are interested in how production and distribution processes are organized across different industries and multinational companies;
- want to design efficient systems, optimize processes and manage resources and people;
- aim to work at the border of engineering and management, with a focus on supply chain management, logistics, project management, or consulting.

The Industrial Engineering & Management BSc program has received excellent results in the most recent university ranking conducted by the Center for Higher Education (CHE, see https://ranking.zeit.de/che/de/fachbereich/603233.The CHE ranking is based on a comparison of more than 300 universities and other higher education institutions. The main indicators are teaching quality, research, and study environment. In most of these criteria Industrial Engineering & Management at Jacobs University has been placed in the top group.

Moreover, previous IEM students have been awarded for the research conducted as part of their thesis projects. They have received thesis awards such as the Scientific Prize of the OLB Foundation and the Thesis Award of the German Logistics Association (BVL). They have also contributed to published papers in conferences such as the IEEE International Conference on Industrial Engineering and Engineering Management (IEEM), the International Symposium of Logistics (ISL) and the CIRP-sponsored International Conference on Changeable, Agile, Reconfigurable and Virtual Production (CARV).

## 1.2 Specific Advantages of the Industrial Engineering & Management Program at Jacobs University

Of the many reasons to enroll in the IEM program at Jacobs University, these stand out:

- High-Quality Teaching:

  Our IEM faculty teaches students about current trends in industrial engineering and management using innovative teaching approaches. Small-to-medium laboratory classes, seminars and tutorials accompanying the lectures give space for effective learning and closer professor-student interaction. Students are encouraged to ask questions and propose interesting topics. In-class exercises and case studies ensure an understanding of theoretical concepts and their applications, as well as an analysis of the current market and its issues. Moreover, during their studies, students also receive individual academic support and career advising.

- Lecturers from Renowned Industrial Companies:

  The IEM program incorporates several modules taught by lecturers from renowned German corporations, such as Porsche, Daimler, Schaeffler and 4flow. In their modules, lecturers teach theoretical concepts coupled with practical applications and examples from their company and the industry sector they are working in. Thus, students get to learn about the best practices of different industries directly from the experts.

- Practical Experience Through Internship Project:

  All students spend their fifth semester doing an internship lasting between four to six months, which enables them to acquire valuable practical experience and is an essential part of the IEM program. We have established close connections with numerous companies and organizations around the globe through our alumni community and Career Services Center which also help students during their applications. These companies include Airbus, Amazon, Daimler, Barry Callebaut, KPMG, Ab-InBev, and Volkswagen.

- Hands-on Learning:

  Classes at Jacobs provide hands-on learning through interactive business games, case studies and creative group work. Another advantageous quality is the close cooperation with industries in the Bremen area and beyond. Field trips, real-world projects with companies and guest lectures offer students opportunities to not only gain insights into industrial processes but to understand the theory learnt in class on a practical case scenario. These also help students establish their first industry connections as well, useful for the Internship Project and professionally.

- Involvement in Research and Industrial Projects:

  Within the study program, IEM students can be actively involved in industrial and research projects carried out by the faculty. Our faculty has performed diverse consulting projects with several renowned industrial companies. Moreover, the IEM research activities at Jacobs University are focused on specific fields of industrial engineering, aiming at optimizing production and distribution systems in an increasingly globalized market.

- Networking Opportunities:

Several explicit networking events are built into the program. They are provided in the form of career events, such as "IEM Internship Day", the annual Career Fair, company visits and field days. Moreover, Jacobs' international campus is the perfect environment for the IEM program, as our students are exposed to an intercultural setting that prepares them for a career in global industrial corporations.

- Data analysis, visualization and management tools:

  During the program, IEM students will learn to use statistical, data analysis and data visualization tools (e.g. Excel, Python, and R). In class, students will work with given datasets and practice with these tools to recognize when they are appropriate and thus, be able to use them for research analysis and presentations in both their theses and internships.

## 1.3 Program-specific Educational Aims

### 1.3.1 Qualification Aims

The Jacobs B.Sc. program in Industrial Engineering & Management aims to prepare young talents for careers at the interface between the management and engineering business functions and teaches them to adapt naturally to interdisciplinary and intercultural surroundings. The program covers the key industrial engineering and management frameworks, concepts and tools necessary to design, plan, control and manage industrial systems, thus preparing graduates for successful careers in industry.

Furthermore, by being part of an international campus, students can work with people from different nationalities and cultural background, thus learning to work in multinational teams. This will also contribute to their personal development, by shaping their attitudes while they learn to engage with different types of people as they will do later in their academic and professional endeavors.

### 1.3.2 Intended Learning Outcomes

By the end of this program, students will be able to:

- apply knowledge of engineering, management, logistics, and mathematics to identify, formulate, and solve problems in the field of industrial engineering;
- use current academic techniques, skills, and modern industrial engineering and management tools necessary for industrial practice (e.g. ABC/XYZ Analysis, Value Stream Mapping, Process Modeling and Simulation, Linear Programming, Demand Forecasting Methods, CAD drawings, Porter's 5 Forces, SWOT & PESTEL analyses, Business Model Canvas.);
- create solutions to real industrial situations applying principles of industrial engineering, business administration, strategy, logistics and supply chain management (as seen in case studies and examples in class);
- design and conduct experiments, as well as analyze and interpret data with the help of software (e.g. R) and programming languages (e.g. Python);
- design a system or process to meet desired needs within realistic constraints, such as economic, environmental, social, health and safety, manufacturability, and sustainability constraints;

- critically analyze industrial problems and make operational and strategic decisions involving complex or conflicting objectives;
- discuss the financial issues of a project and provide structured management reports about project progress;
- take on responsibility in and lead a diverse and multidisciplinary team consisting of both technical and management professionals;
- professionally communicate their conclusions and recommendations in both spoken and written form, and convey the underlying information and their reasons to specialists and non-specialists both clearly and unambiguously based on the state of research and application;
- discuss how the political, economic, social, and technological environments affect business functions in a globalized world;
- use academic or scientific methods as appropriate in the field of industrial engineering and management, such as defining research questions, justifying methods, collecting, assessing and interpreting relevant information, and drawing scientifically-founded conclusions that consider social, scientific and ethical insights;
- develop and advance solutions to problems and arguments in their subject area and defend these in discussions with specialists and non-specialists;
- engage ethically with academic, professional, and wider communities and actively contribute to a sustainable future, reflecting and respecting different views;
- take responsibility for their own learning, personal and professional development and role in society, evaluating critical feedback and self-analysis;
- apply their knowledge and understanding to a professional context;
- adhere to and defend ethical, scientific, and professional standards.

## 1.4 Career Options

Because of the incorporation of management and engineering modules, graduates of the IEM program get a wide spectrum of opportunities in both the professional and academic sectors. The profile of the B.Sc. Industrial Engineering & Management graduate is of great interest to national and international, medium and large-sized, trade and service industry companies. Graduates are especially qualified not only for for tasks in the fields of Logistics, Supply Chain Management (SCM), Procurement, Manufacturing and Automation, Process Optimization, and Information Technology (IT), but also for tasks from other engineering and management disciplines. The career paths that are open for graduates are as versatile as the major's theme. They range from specializations as experts in the production logistics areas through project management careers in different fields to consulting/auditing.

After graduation, students will excel at fulfilling various project responsibilities by applying the gained knowledge in the areas of manufacturing, distribution systems, supply chain management, project management, leadership, entrepreneurship, and team management. Close contacts are established with numerous companies both through field trips, networking events such as the Career Fair and guest lectures. These can help students obtain internships or jobs as graduates at enterprises such as Airbus, Amazon, Daimler, Barry Callebaut, Zalando, Röhlig, Porsche, Lufthansa Cargo, Hello Fresh, and KPMG.Past graduates have also chosen to continue their education by undertaking a graduate degree at universities such as the University of Cambridge, Rotterdam School of Management, Vienna University of Economics and Business, Bocconi University, Dartmouth College, TU Munich, TU Berlin, and KU Leuven.

The Career Services Center (CSC) as well as the Jacobs Alumni Office help students in their career development. The CSC provides students with high quality training and coaching in CV creation, cover letter formulation, interview preparation, effective presenting, business etiquette and employer research as well as in many other areas, thus helping students identify and follow up rewarding careers after their time at Jacobs University. Furthermore, the Alumni Office helps students establish a long-lasting and worldwide network which comes in handy when exploring job options in academia, industry, and elsewhere.

## 1.5 Admission Requirements

Admission to Jacobs University is selective and based on a candidate's school and/or university achievements, recommendations, self-presentation, and performance on required standardized tests. Students admitted to Jacobs University demonstrate exceptional academic achievements, intellectual creativity, and the desire and motivation to make a difference in the world.

The following documents need to be submitted with the application:

- Recommendation Letter
- Official or certified copies of high school/university transcripts
- Educational History Form
- Standardized test results (SAT/ACT/TestAS) – if applicable
- ZeeMee electronic resume (optional)
- Language proficiency test results (TOEFL, IELTS or equivalent)

German language proficiency is not required, instead, all applicants need to submit proof of English proficiency.

For any student who has acquired the right to study at a university in the country where she/he has acquired the higher education entrance qualification Jacobs University accepts the common international university entrance tests in placement of the entrance examination. Applicants with a subject-related entrance qualification (fachgebundene Hochschulreife) may be admitted only to the respective study programs.

For more detailed information about the admission visit: https://www.jacobs-university.de/study/undergraduate/application-information

## 1.6 More Information and Contact

For more information, please contact the study program chair:

Dr. Stanislav Chankov
University Lecturer in Supply Chain Management
Email: s.chankov@jacobs-university.de
Telephone: +49 421 200-3076

or visit our program website: http://iem-program.user.jacobs-university.de/.

# 2 The Curricular Structure

## 2.1 General

The curricular structure provides multiple elements for enhancing employability, interdisciplinarity, and internationality. The unique Jacobs Track, offered across all undergraduate study programs, provides comprehensive tailor-made modules designed to achieve and foster career competency. Additionally, a mandatory internship of at least two months after the second year of study and the possibility to study abroad for one semester give students the opportunity to gain insight into the professional world, apply their intercultural competences and reflect on their roles and ambitions for employment and in a globalized society.

All undergraduate programs at Jacobs University are based on a coherently modularized structure, which provides students with an extensive and flexible choice of study plans to meet the educational aims of their major as well as minor study interests and complete their studies within the regular period.

The framework policies and procedures regulating undergraduate study programs at Jacobs University can be found on the website (https://www.jacobs-university.de/academic-policies).

## 2.2 The Jacobs University 3C Model

Jacobs University offers study programs that comply with the regulations of the European Higher Education Area. All study programs are structured according to the European Credit Transfer System (ECTS), which facilitates credit transfer between academic institutions. The three-year under-graduate program involves six semesters of study with a total of 180 ECTS credit points (CP). The undergraduate curricular structure follows an innovative and student-centered modularization scheme - the 3C-Model - that groups the disciplinary content of the three study years according to overarching themes:

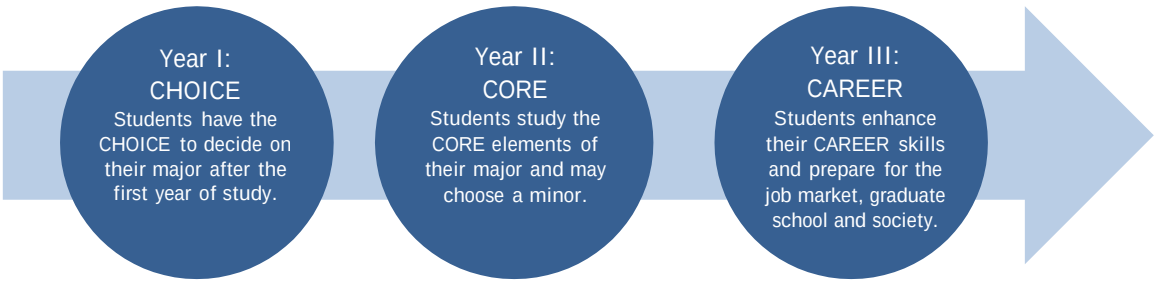



*Figure 1: The Jacobs University 3C-Model*

### 2.2.1 Year 1 – CHOICE

The first study year is characterized by a university-specific offering of disciplinary education that builds on and expands upon the students' entrance qualifications. Students select introductory modules for a total of 45 CP from the CHOICE area of a variety of study programs, of which 15-30 CP will be from their intended major. A unique feature of our curriculum

structure allows students to select their major freely upon entering Jacobs University. The Academic Advising Coordinator offers curricular counseling to all Bachelor students independently of their major, while Academic Advisors support students in their decision-making regarding their major study program as contact persons from the faculty.

To pursue Industrial Engineering & Management as a major, students take the following mandatory CHOICE modules (30 CP)

- CHOICE Module: General Industrial Engineering (7.5 CP)
- CHOICE Module: General Logistics (7.5 CP)
- CHOICE Module: Introduction to International Business (7.5 CP)
- CHOICE Module: Introduction to Finance and Accounting (7.5 CP)

Thus, students will learn the fundamentals of industrial engineering, industrial management, manufacturing technology, logistics systems, and supply chains as well as the important business functions in the globalized world.

The remaining CHOICE modules (15 CP) can be selected in the first year of studies according to interest and with the aim to allow a change of major until the beginning of the second year, when the major choice becomes fixed (see 2.2.1.1 below).

#### 2.2.1.1 Major Change Option

Students can still change to another major at their beginning of the second year of studies if they have taken the corresponding mandatory CHOICE modules in their first year of studies. All students must participate in a seminar on the major change options in the O-Week and consult their Academic Advisor in the first year of studies prior to changing their major.

IEM students that would like to retain an option for a major change are strongly recommended to register for the CHOICE modules of one of the following study programs in their first year. The module descriptions can be found in the respective Study Program Handbook.

- International Business Administration (IBA)
  CHOICE Module: Microeconomics (7.5 CP)
  CHOICE Module: Macroeconomics (7.5 CP)

- Global Economics and Management (GEM)
  CHOICE Module: Microeconomics (7.5 CP)
  CHOICE Module: Macroeconomics (7.5 CP)

- Psychology
  CHOICE Module: Essentials of Cognitive Psychology (7.5 CP)
  CHOICE Module: Essentials of Social Psychology (7.5 CP)

- Integrated Social Sciences (ISS)
  CHOICE Module: Introduction to the Social Sciences 1: Politics and Society (7.5 CP)
  CHOICE Module: Introduction to the Social Sciences 2: Media and Society (7.5 CP)

- Earth and Environmental Studies (EES)
  CHOICE Module: General Earth and Environmental Sciences (7.5 CP)

CHOICE Module: General Geology (7.5 CP)

### 2.2.2 Year 2 – CORE

In their second year, students will take a total of 45 CP from in-depth, discipline-specific CORE modules. Building on the introductory CHOICE modules and applying the methods and skills acquired so far (see 2.3.1), these modules aim to extend the students' critical understanding of the key theories, principles, and methods from both industrial engineering and management. The IEM CORE modules are divided into three units:

1) "Advanced Industrial Engineering", consisting of the modules:

   - CORE Module: Process Modelling & Simulation (5 CP)
   - CORE Module: Production Planning & Control (5 CP)
   - CORE Module: Product & Production System Design (5 CP)

   This unit takes an in-depth look into production systems, providing the students with understanding of product development and design activities, production planning and control methods, as well as the modeling and simulation of the entire manufacturing processes.

2) "Advanced Industrial Management", consisting of the modules:

   - CORE Module: Operations Research (5 CP)
   - CORE Module: Lean Supply Management (5 CP)
   - CORE Module: Production & Technology Management (5 CP)

   In this unit, students will learn to model decision-making problems, to develop purchasing strategies, to employ advanced lean methods for the elimination of waste in industrial processes, and to manage innovation and technologies.

3) "Project & Strategic Management", consisting of the modules:

   - CORE Module: Applied Project Management (7.5 CP)
   - CORE Module: International Strategic Management (7.5 CP)

   This unit prepares students to set up, organize, manage and control projects as well as to evaluate and design strategies in international management.

#### 2.2.2.1 Minor Option

Because of the incorporation of management and engineering modules, IEM students do not have the option to minor in another study program within the 180 CP required for the bachelor's degree.

### 2.2.3 Year 3 – CAREER

During their third year, IEM students prepare for and make decisions about their career after graduation. The third year also focuses on the responsibility of students beyond their discipline and in their fifth semester students will undertake an internship that prepares them for their careers. The sixth semester is dedicated to fostering the research experience of students by

involving them in an extended Bachelor thesis project. In addition, in the 6th semester students also choose between different Specialization modules thus further developing their skills in the fields of product design, innovative technologies, or supply chain management and logistics by working on diverse and challenging projects and case studies.

#### 2.2.3.1 Internship / Start-up and Career Skills Module

As a core element of Jacobs University's employability approach students are required to engage in a mandatory internship. Gaining practical experience is especially important for the IEM program, therefore students will complete a four-month program-specific internship (30 CP) in the fifth semester of study. This curricular component gives students the opportunity to gain first-hand experience in a professional environment, apply their knowledge and understanding to a professional context, reflect on the relevance of their major to their career and society, reflect on their own role in their future working life and society, and find professional orientation. The internship can also establish a contact for the bachelor's thesis project or further employment after graduation. The module is completed by career advising and several career skills workshops throughout all six semesters which prepare students for the transition from student life to working life as well as for their future career. As an alternative to the full-time internship, students interested in setting up their own company can apply for a startup option to focus on the development of their business plan.

For further information, please contact the Career Services Center (https://www.jacobs-university.de/career-services).

#### 2.2.3.2 Specialization Modules

In the third year of their studies, students take 15 CP from major-specific or major-related, advanced Specialization modules to consolidate their knowledge and to be exposed to state-of-the-art research in the areas of their interest. This curricular component is offered as a portfolio of modules, from which students can make free selections during their fifth and sixth semester. The default specialization module size is 5 CP, with smaller 2.5 CP modules being possible as justified exceptions.

To pursue Industrial Engineering & Management as major, at least 15 CP from the following mandatory elective Specialization Modules need to be taken:

- Specialization: Industry 4.0 and Blockchain Technologies (5 CP)
- Specialization: Advanced Product Design (5 CP)
- Specialization: Supply Chain Design (2.5 CP)
- Specialization: Integrated Decision Making in Supply Chain Management (2.5 CP)
- Specialization: Distribution & E-Commerce (2.5 CP)
- Specialization: Law of Transportation, Forwarding and Logistics (2.5 CP)

The first two modules focus more on technology and design aspects, while the latter four modules provide a deeper look in different elements of supply chain management and logistics.

#### 2.2.3.3 Study Abroad

The curriculum of IEM does not define a certain mobility window for study abroad. Students who desire to pursue this option have the option of individually arranging their study abroad stay.

For further information, please contact the International Office: (see: https://www.jacobs-university.de/study/international-office).

#### 2.2.3.4 Bachelor Thesis/Seminar Module

This module is a mandatory graduation requirement for all undergraduate students. It consists of two module components in the major study program guided by a Jacobs faculty member: the Bachelor Thesis (12 CP) and a Seminar (3 CP). The title of the thesis will appear on the students' transcripts.

Within this module, students apply the knowledge skills, and methods they have acquired in their major discipline to become acquainted with actual research topics, ranging from the identification of suitable (short-term) research projects, preparatory literature searches, the realization of discipline-specific research, and the documentation, discussion, and interpretation of the results.

With their Bachelor Thesis students demonstrate mastery of the contents and methods of their major-specific research field. Furthermore, students show the ability to analyze and solve a well-defined problem with scientific approaches, a critical reflection of the status quo in scientific literature, and the original development of their own ideas. With the permission of a Jacobs Faculty Supervisor, the Bachelor Thesis can also have an interdisciplinary nature. In the seminar, students present and discuss their theses in a course environment and reflect on their theoretical or experimental approach and conduct. They learn to present their chosen research topics concisely and comprehensively in front of an audience and to explain their methods, solutions, and results to both specialists and non-specialists.

## 2.3 The Jacobs Track

The Jacobs Track for students majoring in IEM runs parallel to the disciplinary CHOICE, CORE, and CAREER modules across all study years and is an integral part of all undergraduate study programs. It reflects a university-wide commitment to an in-depth training in scientific methods, fosters an interdisciplinary approach, raises awareness of global challenges and societal responsibility, enhances employability, and equips students with extra skills desirable in the general field of study. Additionally, it integrates (German) language and culture modules.

### 2.3.1 Methods and Skills Modules

Methods and skills such as mathematics, statistics, programming, data handling, presentation skills, academic writing, and scientific and experimental skills are offered to all students as part of the Methods and Skills area in their curriculum. The modules that are specifically assigned to each study programs equip students with transferable academic skills. They convey and practice specific methods that are indispensable for each students' chosen study program. Students are required to take 20 CP in the Methods and Skills area. The size of all Methods and Skills modules is 5 CP.

To pursue IEM as a major, the following Methods and Skills modules (20 CP) need to be taken as mandatory modules:

- Methods Module: Applied Calculus (5 CP)
- Methods Module: Finite Mathematics (5 CP)
- Methods Module: Programming in Python (5 CP)

- Methods Module: Applied Statistics with R (5 CP)

The first two modules establish a good mathematics foundation, while the latter two modules prepare students to analyze and interpret data with the help of software (R) and programming languages (Python).

### 2.3.2 Language Modules

Communication skills and foreign language abilities foster students' intercultural awareness and enhance their employability in an increasingly globalized and interconnected world. Jacobs University supports its students in acquiring and improving these skills by offering a variety of language modules at all proficiency levels. Emphasis is put on fostering the German language skills of international students as they are an important prerequisite for non-native students to learn about, explore, and eventually integrate into their host country and its professional environment. Students who meet the required German proficiency level (e.g., native speakers) are required to select modules in any other modern foreign language offered (Chinese, French or Spanish). Hence, acquiring 10 CP in language modules, with German mandatory for non-native speakers, is a requirement for all students. This curricular component is offered as a four-semester sequence of foreign language modules. The size of the Language Modules is 2.5 CP.

# 3 Industrial Engineering & Management as a Minor

## 3.1 Educational Aims of this Program for Minor Students

### 3.1.1 Qualification Aims

The Jacobs minor in Industrial Engineering & Management aims to prepare young talents for careers at the interface between the management and engineering business functions. The program covers some of the key industrial engineering frameworks, concepts and tools necessary to design, plan, and control industrial systems.

### 3.1.2 Intended Learning Outcomes

By the end of this program, students will be able to

- apply knowledge of engineering and logistics to identify, formulate, and solve problems in the field of industrial engineering;
- use current academic techniques and skills, and modern industrial engineering tools necessary for industrial practice (e.g. ABC/XYZ Analysis, Process Modeling and Simulation, Demand Forecasting Methods, CAD drawings);
- create solutions to real industrial situations applying principles of logistics and supply chain management (as seen in case studies and examples in class);
- design a system or process to meet desired needs within realistic constraints, such as economic, environmental, social, health and safety, manufacturability, and sustainability constraints.

## 3.2 Module Requirements

A minor in IEM requires 30 CP. The default option for obtaining a minor in IEM is shown in the Study and Examination Plan. It includes the first-year unit "General Industrial Engineering and Logistics" and the second-year unit "Advanced Industrial Engineering" with the following CHOICE and CORE modules:

CHOICE Module: General Industrial Engineering (7.5 CP)

CHOICE Module: General Logistics (7.5 CP)

CORE Module: Production Planning & Control (5 CP)

CORE Module: Product & Product System Design (5 CP)

CORE Module: Process Modeling and Simulation (5 CP)

## 3.3 Degree

After successful completion the minor in Industrial Engineering & Management will be listed on the final transcript under PROGRAM OF STUDY and BA/BSc – [name of the major] as "(Minor: Industrial Engineering and Management)".

# 4 Industrial Engineering & Management Undergraduate Program Regulations

## 4.1 Scope of these Regulations

The regulations in this handbook are valid for all students who entered the Industrial Engineering & Management undergraduate program at Jacobs University in Fall 2019. In case of conflict between the regulations in this handbook and the general Policies for Bachelor Studies, the latter applies (see http://www.jacobs-university.de/academic-policies).

In exceptional cases, certain necessary deviations from the regulations of this study handbook might occur during the course of study (e.g., change of the semester sequence, assessment type, or the teaching mode of courses). Jacobs University Bremen reserves therefore the right to modify the regulations of the program handbook.

## 4.2 Degree

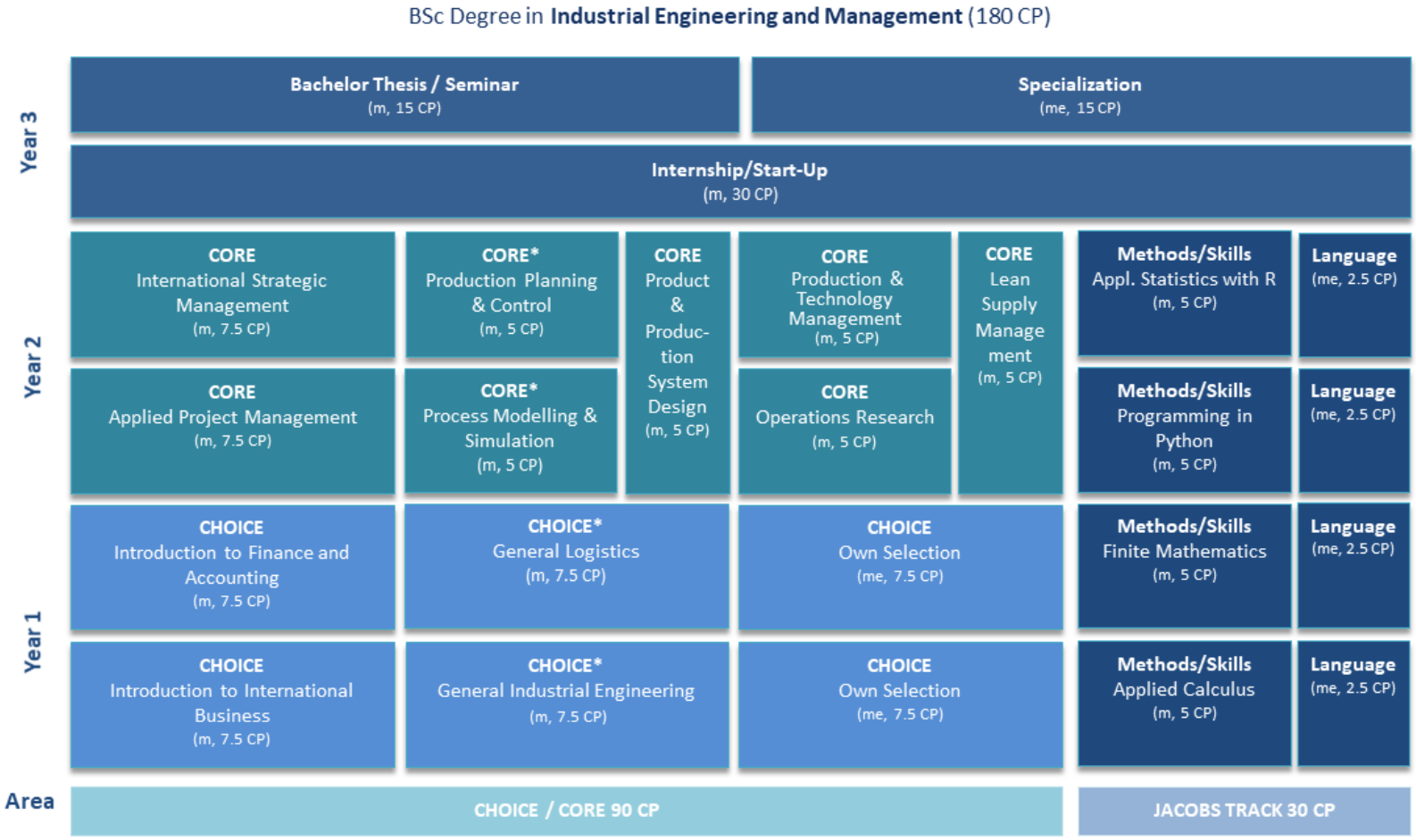
Upon successful completion of the study program, students are awarded a Bachelor of Science (BSc) degree in Industrial Engineering and Management.

## 4.3 Graduation Requirements

In order to graduate, students need to obtain 180 CP. In addition, the following graduation requirements apply: Students need to complete all mandatory components of the program as indicated in Chapter 2 of this handbook.

## 5 Schematic Study Plan for Industrial Engineering and Management

*Figure 2* shows schematically the sequence and types of modules required for the study program. A more detailed description, including the assessment types, is given in the Study and Examination Plans in the following section.




* mandatory for minor students (default minor)
m = mandatory
me = mandatory elective

# 6 Study and Examination Plan

## Industrial Engineering and Management (IEM) BSc

**Matriculation Fall 2019**

| | Program-Specific Modules | Type | Assessment | Period | Status[1] | Sem. | CP |
|---|---|---|---|---|---|---|---|
| **Year 1 - CHOICE** | | | | | | | **45** |
| *Take the mandatory CHOICE modules listed below, this is a requirement for IEM program.* | | | | | | | |
| | **Unit: General Industrial Engineering and Logistics** (Default minor) | | | | | | **15** |
| **CH-240** | **Module: General Industrial Engineering** | | | | **m** | **1** | **7.5** |
| CH-240-A | Industrial Engineering | Lecture | Written examination | Examination period | | | 5 |
| CH-240-B | Basics of Manufacturing Technology | Lab | | During the semester | | | 2.5 |
| **CH-241** | **Module: General Logistics** | | | | **m** | **2** | **7.5** |
| CH-241-A | Introduction to Logistics & SCM | Lecture | Written examination | Final exam period | | | 5 |
| CH-241-B | Logistics Lab | Lab | and project | During the semester | | | 2.5 |
| **CH-300** | **Module: Introduction to International Business** | | | | **m** | **1** | **7.5** |
| CH-300-A | Introduction to International Business Lecture | Lecture | Written examination | Examination period | | | 5 |
| CH-300-B | Introduction to International Business Seminar | Seminar | and case studies | During the semester | | | 2.5 |
| **CH-301** | **Module: Introduction to Finance and Accounting** | | | | **m** | **2** | **7.5** |
| CH-301-A | Introduction to Finance | Lecture | | | | | 2.5 |
| CH-301-B | Introduction to Accounting | Lecture | Written examination | Final exam period | | | 2.5 |
| CH-301-C | Finance and Accounting Tutorial | Tutorial | | | | | 2.5 |
| | **Unit: CHOICE (own selection)** | | | | | **1/2** | **15** |
| *Take two further CHOICE modules from those offered for all other study programs.[2]* | | | | | | | |
| **Year 2 - CORE** | | | | | | | **45** |
| *Take all CORE modules listed below.* | | | | | | | |
| | **Unit: Advanced Industrial Engineering** (Default minor) | | | | | | **15** |
| **CO-582** | **Module: Process Modelling & Simulation** | | | | **m** | **3** | **5** |
| CO-582-A | Process Modelling & Simulation | Lab | Project | During the semester | | | |
| **CO-581** | **Module: Product & Production System Design** | | | | **m** | **3+4** | **5** |
| CO-581-A | Fundamentals of Engineering Design | Lab | Written examination | Examination period | | 3 | 2.5 |
| CO-581-B | Advanced Production System Design | Lecture | and project | During the semester | | 4 | 2.5 |
| **CO-580** | **Module: Production Planning & Control** | | | | **m** | **4** | **5** |
| CO-580-A | Production Planning & Control | Lecture | Written examination | Examination period | | | |
| | **Unit: Advanced Industrial Management** | | | | | | **15** |
| **CO-583** | **Module: Operations Research** | | | | **m** | **3** | **5** |
| CO-583-A | Operations Research | Lecture | Written examination | Examination period | | | |
| **CO-584** | **Module: Lean Supply Management** | | | | **m** | **3+4** | **5** |
| CO-584-A | Advanced Lean Methods | Seminar | Written examination | Examination period | | 3 | 2.5 |
| CO-584-B | Purchasing & Supply Management | Seminar | and term paper | During the semester | | 4 | 2.5 |
| **CO-585** | **Module: Production & Technology Management** | | | | **m** | **4** | **5** |
| CO-585-A | Prodution & Technology Management | Lecture | Project | During the semester | | | |
| | **Unit: Management** | | | | | | **15** |
| **CO-600** | **Module: Applied Project Management** | | | | **m** | **3** | **7.5** |
| CO-600-A | Applied Project Management Lecture | Lecture | Presentation | During the semester | | | 5 |
| CO-600-B | Applied Project Management Seminar | Seminar | | | | | 2.5 |
| **CO-601** | **Module: International Strategic Management** | | | | **m** | **4** | **7.5** |
| CO-601-A | International Strategic Management Lecture | Lecture | Term paper | During the semester | | | 5 |
| CO-601-B | International Strategic Management Seminar | Seminar | | | | | 2.5 |
| **Year 3 - CAREER** | | | | | | | **60** |
| **Module Code** | **Module: Guided Industrial Project / Mandatory Internship** | | | | **m** | **5** | **30** |
| CA-INT-901 | Guided Industrial Project / Mandatory Internship | Internship | Report or Business plan and poster | During the 5th semester | | | |
| **CA-IEM-800** | **Module: Thesis / Seminar IEM** | | | | **m** | **6** | **15** |
| CA-IEM-800-T | Thesis IEM | Thesis | Thesis | 15th of May | | | 12 |
| CA-IEM-800-S | Seminar IEM | Seminar | Poster presentation | During the semester | | | 3 |
| | **Unit: Specialization IEM** | | | | **m** | **6** | **15** |
| *Take a total of 15 CP of specialization modules* | | | | | | | |
| CA-S-IEM-801 | Industry 4.0 and Blockchain Technologies | Lecture/Seminar | Project | During the semester | me | | 5 |
| CA-S-IEM-802 | Advanced Product Design | Lab | Project | During the semester | me | | 5 |
| CA-S-IEM-803 | Supply Chain Design | Seminar | Project | During the semester | me | | 2.5 |
| CA-S-IEM-804 | Integrated Decision Making in Supply Chain Management | Seminar | Project | During the semester | me | | 2.5 |
| CA-S-IEM-805 | Distribution & E-Commerce | Lecture | Project | During the semester | me | | 2.5 |
| CA-S-IEM-806 | Law of Transportation, Forwarding and Logistics | Lecture | Written examination | Examination period | me | | 2.5 |
| **Tota CP** | | | | | | | **180** |

| | Jacobs Track Modules (General Education) | Type | Assessment | Period | Status[1] | Sem. | CP |
|---|---|---|---|---|---|---|---|
| | **Unit: Methods / Skills** | | | | | | **10** |
| *Take one of the two mandatory elective methods modules listed below.* | | | | | | | |
| **JTMS-MAT-08** | **Module: Applied Calculus** | | | | **m** | **1** | **5** |
| JTMS-08 | Applied Calculus | Lecture | Written examination | Examination period | | | |
| **JTMS-MAT-11** | **Module: Finite Mathematics** | | | | **m** | **2** | **5** |
| JTMS-11 | Finite Mathematics | Lecture | Written examination | Examination period | | | |
| | **Unit: Language** | | | | | | **5** |
| | German is the default language. Native German speakers take modules in another offered language. | | | | | | |
| **JTLA-xxx** | **Module: Language 1** | | | | **m** | **1** | **2.5** |
| JTLA-xxx | Language 1 | Seminar | Various | Various | me | | |
| **JTLA-xxx** | **Module: Language 2** | | | | **m** | **2** | **2.5** |
| JTLA-xxx | Language 2 | Seminar | Various | Various | me | | |
| | **Unit: Methods / Skills** | | | | | | **10** |
| **JTMS-SKI-14** | **Module: Programming in Python** | | | | **m** | **3** | **5** |
| JTMS-14 | Programming in Python | Lecture | Written examination | Examination period | | | |
| **JTMS-MET-03** | **Module: Applied Statistics with R** | | | | **m** | **4** | **5** |
| JTMS-03 | Applied Statistics with R | Lecture/Lab | Written examination | Examination period | | | |
| | **Unit: Language** | | | | | | **5** |
| | German is the default language. Native German speakers take modules in another offered language. | | | | | | |
| **JTLA-xxx** | **Module: Language 3** | | | | **m** | **3** | **2,5** |
| JTLA-xxx | Language 3 | Seminar | Various | Various | me | | |
| **JTLA-xxx** | **Module: Language 4** | | | | **m** | **4** | **2,5** |
| JTLA-xxx | Langauge 4 | Seminar | Various | Various | me | | |



*Figure 3: Study and Examination Plan*

# 7 Module Descriptions

## 7.1 General Industrial Engineering

<table>
<tr><td colspan="3">Module Name<br><br>General Industrial Engineering</td><td>Module Code<br><br>CH-240</td><td>Level (type)<br><br>Year 1 (Choice)</td><td>CP<br><br>7.5</td></tr>
<tr><td colspan="6">Module Components<br><br>Number | Name | Type | CP</td></tr>
<tr><td>CH-240-A</td><td colspan="3">Industrial Engineering</td><td>Lecture</td><td>5</td></tr>
<tr><td>CH-240-B</td><td colspan="3">Basics of Manufacturing Technology</td><td>Lab</td><td>2.5</td></tr>
<tr><td>Module Coordinator<br><br>Prof. Dr. Yilmaz Uygun</td><td colspan="3">Program Affiliation<br><br>• Industrial Engineering & Management (IEM)</td><td colspan="2">Mandatory Status<br><br>Mandatory for IEM students</td></tr>
<tr><td colspan="3">Entry Requirements<br><br>Pre-requisites: ☒ None<br>Co-requisites: ☒ None<br>Knowledge, Abilities, or Skills: ☒ None</td><td>Frequency<br><br>Annually (Fall)</td><td colspan="2">Forms of Learning and Teaching<br><br>• Lectures (35 hours)<br>• Labs (17.5 hours)<br>• Group work (45 hours)<br>• Private study (90 hours)</td></tr>
<tr><td colspan="3"></td><td>Duration<br><br>1 semester</td><td colspan="2">Workload<br><br>187.5 hours</td></tr>
<tr><td colspan="6">Recommendations for Preparation<br><br>Maynard, H.B. & Zandin K. B. (2001). Maynard's Industrial Engineering Handbook. McGraw Hill Professional, 5th Edition.<br><br>Salvendy, G. (2001). Handbook of Industrial Engineering – Technology and Operations Management. John Wiley & Sons, Inc; 3rd edition.</td></tr>
<tr><td colspan="6">The module gives a broad introduction to the industrial engineering field. Industrial engineering is an application-oriented scientific discipline that deals with the creation and management of systems that integrate people and materials and energy in productive ways. Thus, the lecture-based "Industrial Engineering" module component covers topics from developing a product to its final manufacturing by looking at closely related and intertwined aspects, ranging from product design to production process design. All these topics are organized in consecutive chapters. Here, the starting point is product development, where the process of how to efficiently develop a product prototype is shown. The course discusses the importance of materials and properties that meet the specified requirements, followed by a look at standard machine elements that facilitate the fabrication of a product. Another important aspect is engineering drawings that help visualize the products, containing dimensions and materials. Besides product-related aspects, manufacturing machines and processes need to be chosen, and the required quantity must be calculated, which is covered in the "Manufacturing Processes" chapter. Here, the most common production technologies and the possibilities of the machinery used in the production processes in the engineering industry will be dealt with in detail. Manufacturing technologies and processes such as casting, milling, and welding will be addressed. Additionally, manual work stations will be analyzed as well in order to understand ergonomic aspects. Once the required number of machines is given, they need to be mapped and aligned on the factory shop floor, which will be dealt with in another chapter. After designing products and</td></tr>
</table>

production processes, the actual manufacturing with receiving orders and scheduling them may take place. Course topics include bill of materials, route sheets, and schedules. The necessary methods will be presented in the "Production Planning and Control" chapter. Eventually, selected trends in manufacturing that help improve the daily work of an industrial engineer will be discussed.

The lab-based module component "Basics of Manufacturing Technology" allows students to apply their knowledge of the main topics covered by the lecture-based module component. Students will be given a comprehensive case study and work in groups to plan detailed real-case production scenarios for manufacturing customer end-products. They will learn how to assess the applicability of the most common production technologies and the possibilities of the machinery used in the production processes in the engineering industry. Topics in operations management, including manufacturing process flow, production planning, bill of materials, and factory layouts, will be addressed in the case studies as well..

*Intended Learning Outcomes*

By the end of this module, students will be able to

- fully comprehend the main responsibilities of industrial engineering;
- understand and manage the whole process from product design to manufacturing;
- choose basic materials (e.g., steel) for different types of products;
- prepare simple engineering drawings;
- calculate the required number of machines for a given scope of manufacturing requirements;
- understand the importance of ergonomics and ergonomic workplace design;
- apply several scheduling techniques for production planning and control;
- reflect on the applicability of current developments and trends in industrial engineering;
- describe the main manufacturing processes such casting, milling, welding, grinding, and the state-of-the-art tools and technologies used in these processes;
- apply the knowledge of manufacturing technologies in planning detailed real-case production scenarios (including the bill of material, types of machinery used, types of production processes used, anticipated production rates) for manufacturing customer end-products.

*Indicative Literature*

Maynard, H.B. & Zandin K. B. (2001). Maynard's Industrial Engineering Handbook. McGraw Hill Professional, 5th Edition.

Salvendy, G. (2001). Handbook of Industrial Engineering – Technology and Operations Management. John Wiley & Sons, Inc; 3rd edition.

Simmons, C.; Maguire, D.(2004). Manual of engineering drawing, 2nd Edition-Newnes.

*Usability and Relationship to other Modules*

- Mandatory for a major in IEM
- Pre-requisite for 2nd-year IEM CORE modules Production Planning & Control, Production Technology Management, Product & Production System Design, Operations Research, Process Modeling & Simulation and Lean Supply Chain Management
- Elective for all other undergraduate study programs.

*Examination Type: Module Component Examination*

*Component 1: Lecture*

Assessment Type: Written examination — Duration: 180 minutes, Weight: 67 %

Scope: Intended learning outcomes 1-10 of the module.

Component 2: Lab

Assessment Type: Project (Group assessment) — Weight: 33 %

Scope: Intended learning outcomes 9-11 of the module.

Completion: To pass this module, the examination of each module component has to be passed with at least 45%.

## 7.2 General Logistics

<table>
<tr><td colspan="3">Module Name<br><br>General Logistics</td><td>Module Code<br><br>CH-241</td><td>Level (type)<br><br>Year 1 (CHOICE)</td><td>CP<br><br>7.5</td></tr>
<tr><td colspan="6">Module Components<br><br>Number | Name | Type | CP<br>CH-241-A | Introduction to Logistics & Supply Chain Management | Lecture | 5<br>CH-241-B | Logistics Lab | Lab | 2.5</td></tr>
<tr><td>Module Coordinator<br><br>Dr. Stanislav Chankov</td><td colspan="3">Program Affiliation<br><br>• Industrial Engineering & Management (IEM)</td><td colspan="2">Mandatory Status<br><br>Mandatory for IEM</td></tr>
<tr><td colspan="3">Entry Requirements<br><br>Pre-requisites<br>☒ None<br><br>Co-requisites<br>☒ None<br><br>Knowledge, Abilities, or Skills<br>• Basic spreadsheet software skills (e.g. MS Excel)</td><td>Frequency<br><br>Annually (Spring)<br><br>Duration<br><br>1 semester</td><td colspan="2">Forms of Learning and Teaching<br><br>• Lectures (35 hours)<br>• Labs (22.5 hours)<br>• Project work (30 hours)<br>• Private Study (100 hours)<br><br>Workload<br><br>187.5 hours</td></tr>
<tr><td colspan="6">Recommendations for Preparation<br><br>Learn or practice basic functions in a spreadsheet software (e.g. MS Excel).</td></tr>
<tr><td colspan="6">Content and Educational Aims<br><br>The module consists of two module components, one lecture and one practical lab.<br><br>In the lecture, students will be introduced to the scope of logistics and supply chain management (SCM). They will get to understand the main logistics goals, processes, and functions as well as the recent and future challenges in logistics and supply chain management with regards to technical, economic, social and environmental factors. The focus is on providing a holistic perspective on three main areas of logistics and SCM: procurement, production, and distribution. Accordingly, the following subjects will be covered: overview of operative procurement, strategic sourcing, production planning and control, distribution logistics, inventory management, supply chain network design, and management of logistics service providers. The students are also given a project task on a specific topic, aimed at improving students' teamwork, project management and presentation skills.<br><br>The lab substantiates and amends the technical concepts taught in the lecture by exercises, experiments and/or simulations. These include exercises to demonstrate the principles of some logistics and industrial engineering methods (e.g., business process modeling, computer simulation of a production process, production planning, and linear programming). In addition, students will also gain practical knowledge by means of two business games. The Presto business game will help students understand the importance of organizing production processes. The Beer Distribution Game (a computer-based business game) will address the bullwhip effect in supply chains and improve students' understanding of logistics and supply chain management.</td></tr>
</table>

*Intended Learning Outcomes*

By the end of this module, students will be able to

- describe the entire value-added chain from the supplier to the customer (the procurement, the production, the distribution and the reverse [waste management] logistics) and its impact on the economic success of the company and on society at large;
- explain the definitions and terms commonly used in the logistics and supply chain management realm;
- explain the linkages and differences between logistics and supply chain management;
- discuss conflicting logistics and supply chain targets and their trade-offs from a holistic perspective;
- describe the processes, strategies, and tools of procurement, production and distribution logistics;
- model business processes with the event-driven process chain notation;
- solve linear programming and transportation problems;
- explain the reasons behind one of the main problems in supply chain management: the Bullwhip effect;
- apply the main methods of analysis in logistics (e.g., ABC/XYZ analysis, Kraljic Matrix, throughput diagram, logistics operating curves, logistics potential analysis, storage model, safety stock calculation);
- create a simulation model for a production process and run a basic simulation study for a production process;
- effectively work in teams to develop and deliver a presentation on a topic in the context of logistics and SCM.

*Indicative Literature*

DHL Trend Research (2019). Logistics Trend Radar, DHL Customer Solutions & Innovation, Troisdorf, Germany.

Cooper, M. C., Lambert, D. M., & Pagh, J. D. (1997). Supply chain management: more than a new name for logistics. The international journal of logistics management, 8(1), 1-14.

Benton, W. C. (2013). Purchasing and Supply Chain Management: Third Edition. McGraw-Hill Higher Education.

Nix, N. W. (2001). Purchasing in a supply chain context. Supply Chain Management, 205-235.

Nyhuis, P., & Wiendahl, H. P. (2008). Fundamentals of production logistics: theory, tools and applications. Springer Science & Business Media.

Nyhuis, P., & Wiendahl, H. P. (2006). Logistic production operating curves–basic model of the theory of logistic operating curves. CIRP Annals-Manufacturing Technology, 55(1), 441-444.

Rushton, A. et al. (2000). The Handbook of Logistics and Distribution Management. Kogan Page.

Andersen, M., & Skjoett-Larsen, T. (2009). Corporate social responsibility in global supply chains. Supply Chain Management: An International Journal,14(2), 75-86.

Banks, J. et al. (2010). Discrete-event System Simulation. 5th edn. Pearson.

*Usability and Relationship to other Modules*

- Mandatory for a major in IEM
- Pre-requisite for 2nd-year IEM CORE modules Production Planning & Control, Production Technology Management, Product & Production System Design, Operations Research, Process Modeling & Simulation and Lean Supply Chain Management
- Elective for all other undergraduate study programs.
- The module builds on the 1st- year IEM CHOICE module General Industrial Engineering

*Examination Type: Module Component Examination*

*Component 1: Lecture*

Assessment Type: Written examination — Duration: 180 minutes, Weight: 67 %

Scope: Intended learning outcomes 1-10 of the module.

Component 2: Lab

Assessment Type: Project (Group assessment) — Weight: 33 %

Scope: Intended learning outcomes 9-11 of the module.

Completion: To pass this module, the examination of each module component has to be passed with at least 45%.

## 7.3 Introduction to International Business

<table>
<tr><td colspan="3">Module Name<br>Introduction to International Business</td><td>Module Code<br>CH-300</td><td>Level (type)<br>Year 1 (CHOICE)</td><td>CP<br>7.5</td></tr>
<tr><td colspan="6">Module Components<br><br>Number | Name | Type | CP</td></tr>
<tr><td>CH-300-A</td><td colspan="3">Introduction to International Business - Lecture</td><td>Lecture</td><td>5</td></tr>
<tr><td>CH-300-B</td><td colspan="3">Introduction to International Business - Seminar</td><td>Seminar</td><td>2.5</td></tr>
<tr><td>Module Coordinator<br><br>Prof. Dr. Christoph Lattemann</td><td colspan="3">Program Affiliation<br><br>• International Business Administration (IBA)</td><td colspan="2">Mandatory Status<br><br>Mandatory for IBA, GEM and IEM</td></tr>
<tr><td colspan="3">Entry Requirements<br><br>Pre-requisites<br>☒ None<br><br>Co-requisites<br>☒ None<br><br>Knowledge, Abilities, or Skills<br>• None</td><td>Frequency<br><br>Annually (Fall)<br><br>Duration<br>1 semester</td><td colspan="2">Forms of Learning and Teaching<br>• Lecture (35 hours)<br>• Seminar (17.5 hours)<br>• Private studies on cases (50 hours)<br>• Private studies on content (85 hours)<br><br>Workload<br>187.5 hours</td></tr>
<tr><td colspan="6">Recommendations for Preparation<br><br>None.</td></tr>
<tr><td colspan="6">Content and Educational Aims<br><br>This module provides the basics needed for making informed and effective business decisions in today's global economy. It focuses on the domains of business such as international strategy and organizational structure, selecting and managing entry modes, developing and marketing products internationally and managing international operations. Issues of globalization, cross-cultural businesses, politics and law in business, economic systems and development, international trade, and international financial markets will also be covered. Upon completing the module, students will know how to use a number of international business analytical tools, and have experience with case study analysis: including, PEST, CAGE, International Market Selection and Modes of Entry. Global corporate social responsibility and sustainability issues will also be discussed.</td></tr>
<tr><td colspan="6">Intended Learning Outcomes<br><br>By the end of this module, students will be able to<br><br>• understand and describe the process of globalization and how it affects markets and production e.g. identify the two forces causing globalization to increase, identify the types of companies that participate in international business, describe the global business environment and identify its four main elements;<br>• describe culture and explain the significance of both national culture and subcultures, identify the components of culture and the impact on business, describe the two main frameworks used to classify cultures and explain their practical use;<br>• describe each main type of political system. Identify the origins of political risk and how managers can reduce its effects. List the main types of legal systems and explain how they differ. Describe the major legal and ethical issues facing international companies;<br>• describe what is meant by a centrally planned economy and explain why its use is declining. Identify the main characteristics of a mixed economy and explain the emphasis on privatization. Describe the different ways to measure a nation's level of development;</td></tr>
</table>

- discuss international trade and trade patterns. Explain absolute advantage and comparative advantage and identify their differences. Explain the factor proportions and international product life cycle theories as well as trade and national competitive advantage theories;
- describe the political, economic, and cultural motives behind governmental intervention in trade. List and explain the methods governments use to promote and restrict international trade;
- define regional economic integration and identify its five levels. Discuss the benefits and drawbacks associated with regional economic integration;
- discuss international capital market, international bond, international equity, and Eurocurrency markets. Discuss the four primary functions of the foreign exchange market. Explain how currencies are quoted and the different rates given;
- explain how exchange rates influence the activities of domestic and international companies. Identify the factors that help determine exchange rates and their impact on business;
- identify international strategies and the corporate-level strategies that companies use;
- discuss the important issues that influence the choice of organizational structure;
- explain why and how companies use exporting, importing, and countertrade. Explain the various means of financing export and import activities. Describe the different contractual entry modes that are available to companies. Discuss the important strategic factors in selecting an entry mode;
- explain the impact globalization is having on international marketing activities. Understand the various dimensions for developing international product, promotional, pricing and distribution strategies (4P's marketing mix);
- use concepts, tools and frameworks and apply them in the international business context. Develop and improve your analytical and critical thinking skills by applying them to contemporary international business issues. Improve communication skills like reading, writing, speaking, and listening. Prepare and deliver oral presentations as well as written works either prepared individually or as a team. Improve your research skills by analyzing real business situations, identifying problems, evaluating and discussing options and prepare recommendations. These recommendations need to be fact-based, undertaken qualitative and quantitative analyses.

*Indicative Literature*

Peng, M., Meyer K. (2019). International Business, 3 ed, Boston: Cengage Learning EMEA.

*Usability and Relationship to other Modules*

- Mandatory for a major in IBA, GEM and IEM
- Mandatory for a minor in IBA
- Pre-requisite for all 2nd-year IBA CORE modules
- Elective for all other undergraduate study programs.

*Examination Type: Module Examination*

Assessment Type: Written examination and Case Studies (preparation of case studies is prerequisite to attend the written examination).

Duration of written examination: 120 minutes
Weight: 100%

Scope: all intended learning outcomes

## 7.4 Introduction to Finance and Accounting

<table>
<tr><td colspan="2">Module Name<br>Introduction to Finance and Accounting</td><td>Module Code<br>CH-301</td><td>Level (type)<br>Year 1 (CHOICE)</td><td>CP<br>7.5</td></tr>
<tr><td colspan="5">Module Components<br><br>Number | Name | Type | CP<br>CH-301-A | Introduction to Finance | Seminar | 2.5<br>CH-301-B | Introduction to Accounting | Seminar | 2.5<br>CH-301-C | Finance and Accounting Tutorial | Tutorial | 2.5</td></tr>
<tr><td>Module Coordinator<br><br>Prof. Dr. Tilo Halaszovich</td><td colspan="2">Program Affiliation<br><br>• International Business Administration (IBA)</td><td colspan="2">Mandatory Status<br><br>Mandatory for IBA, GEM and IEM</td></tr>
<tr><td colspan="2">Entry Requirements<br><br>Pre-requisites<br>☒ Introduction to International Business<br><br>Co-requisites<br>☒ none<br><br>Knowledge, Abilities, or Skills<br>• None.</td><td>Frequency<br><br>Annually (Spring)<br><br>Duration<br>1 semester</td><td colspan="2">Forms of Learning and Teaching<br><br>• Seminars (35 hours)<br>• Tutorial (17.5 hours)<br>• Private Study (135 hours)<br><br>Workload<br>187.5 hours</td></tr>
<tr><td colspan="5">Recommendations for Preparation<br><br>None</td></tr>
<tr><td colspan="5">Content and Educational Aims<br><br>This module introduces students to basic financial and accounting techniques necessary to supplement business decision-making. The module is split into three sub-parts. The first part focuses on finance and investment and will provide students with the basics of corporate finance and investments. It will offer an overview of the different sources of finance from private and public sources and it will introduce the analytical tools and the necessary techniques for the financial management of a firm. It further provides the foundation for the basic domains of entrepreneurial finance, financing small- and medium enterprises and accessing capital markets. This also includes structuring financial activities in projects, funds, mergers and acquisition.<br><br>The second part focuses on measuring the financial position and performance of a firm, on reporting cash flows and on analyzing financial statements. The perspective, thereby, lies on purposes of accounting, principal accounting procedures, sources and recording of data, the verification of accounting records, principles of financial statements, preparation, analysis and interpretation of financial statements, international accounting standards (IFRS), and principles and policies and their differences.<br><br>The third part of the module is designed as tutorial. In the tutorial students will repeat, apply and practice the techniques from both seminars. Students work on exercises individually and in small groups.</td></tr>
</table>

*Intended Learning Outcomes*

By the end of this module, students should be able to:

- understand the theoretical foundation of corporate finance
- understand how public and private financial markets and organizations work
- differentiate the variety of financing sources for companies
- develop a sound understanding how to structure investments
- identify and explain the financial structure of firms
- identify and describe the major functions of financial reporting
- describe and explain the relationship between financial statement elements
- describe the roles and desirable attributes of financial reporting standards
- describe and explain the elements of the balance sheet
- describe, explain and classify cash flow items
- describe and explain tools and techniques used in financial analysis and calculate ratios
- describe and explain characteristics of financial reporting quality

*Indicative Literature*

Phillips, F., Libby,R., Libby P. (2015). Fundamentals of Financial Accounting, 5th Edition. New York: McGraw-Hill Education.

Fraser, L.M., Ormiston, A. (2015). Understanding Financial Statements, 11th Edition, London: Pearson.

Hisrich, R., Peters, M., Shepherd D (2017). Entrepreneurship & Innovation, 10th Edition, New York: McGraw-Hill.

*Usability and Relationship to other Modules*

- Mandatory for a major in IBA, GEM and IEM
- Mandatory for a minor in IBA
- Pre-requisite for all 2nd year IBA CORE modules
- Elective for all other undergraduate study programs
- Builds on the module "Introduction to International Business"
- The module prepares students for the CORE modules in the second and third study year

*Examination Type: Module Examination*

Assessment Type: Written examination Duration: 120 minutes

Weight: 100%

Scope: All intended learning outcomes of the module.

## 7.5 Process Modeling and Simulation

<table>
<tr><td colspan="3">Module Name<br><br>Process Modeling and Simulation</td><td>Module Code<br><br>CO-582</td><td>Level (type)<br><br>Year 2 (CORE)</td><td>CP<br><br>5</td></tr>
<tr><td colspan="6">Module Components<br><br>Number | Name | Type | CP<br>CO-582-A | Process Modeling and Simulation | Lab | 5</td></tr>
<tr><td>Module Coordinator<br><br>Prof. Dr. Yilmaz Uygun</td><td colspan="3">Program Affiliation<br><br>• Industrial Engineering & Management (IEM)</td><td colspan="2">Mandatory Status<br><br>Mandatory for IEM</td></tr>
<tr><td colspan="3">Entry Requirements<br><br>Pre-requisites<br>☒ General Industrial Engineering and General Logistics<br><br>Co-requisites<br>☒ None<br><br>Knowledge, Abilities, or Skills<br>☒ None</td><td>Frequency<br><br>Annually (Fall)<br><br>Duration<br><br>1 semester</td><td colspan="2">Forms of Learning and Teaching<br><br>• Lectures (17.5 hours)<br>• Lab (17.5 hours)<br>• Group work (45 hours)<br>• Private Study (45 hours)<br><br>Workload<br><br>125 hours</td></tr>
<tr><td colspan="6">Recommendations for Preparation<br><br>Chung, C.A. (2004): Simulation Modeling Handbook – A Practical Approach. CRC Press. Boca Raton, FL.</td></tr>
<tr><td colspan="6">Process understanding is highly important in the field of industrial engineering and management. Without knowing processes, there is no opportunity to improve them. Various concepts of process modeling will be introduced, as well as modeling methods and modeling languages. The three most important modeling methods that will be covered in this module are discrete-event, agent-based, and system dynamics. Discrete-event simulation is widely used in industry for the design and analysis of logistical parameters, such as inventory levels, capacity utilization, lead times, and carbon footprint. Agent-based simulation helps model individual agents and their behavior to understand their effect and impact on the overall system. System dynamics, which helps to model a whole system on a highly aggregate level to understand its dynamics via feedback loops, will be dealt with.</td></tr>
<tr><td colspan="6">Intended Learning Outcomes<br><br>By the end of this module, students will be able to<br><br>• distinguish between the three simulation and modeling methods;<br>• create discrete-event simulation models to analyze logistical parameters;<br>• create agent-based models to understand the impact of individual behavior on the overall system;<br>• create system dynamics models to understand the dynamics of a highly aggregate system;<br>• analyze bottlenecks and find improvement potential.</td></tr>
<tr><td colspan="6">Indicative Literature<br><br>Chung, C.A. (2004). Simulation Modeling Handbook – A Practical Approach. CRC Press. Boca Raton, FL.</td></tr>
</table>

*Usability and Relationship to other Modules*

- Mandatory for a major in IEM
- Mandatory for a minor in IEM
- Pre-requisite for 3rd -year IEM Specialization modules and Thesis
- Elective for all other undergraduate study programs.
- The module builds on the 1st -year IEM CHOICE modules General Industrial Engineering and General Logistics.

*Examination Type: Module Examination*

Assessment Type: Project (group assessment) Weight: 100%

Scope: All intended learning outcomes of the module

## 7.6 Product & Production System Design

<table>
<tr><td colspan="3">Module Name</td><td>Module Code</td><td>Level (type)</td><td>CP</td></tr>
<tr><td colspan="3">Product & Production System Design</td><td>CO-581</td><td>Year 2 (CORE)</td><td>5</td></tr>
<tr><td colspan="6">Module Components<br><br>Number | Name | Type | CP<br>CO-581-A | Fundamentals of Engineering Design | Lab | 2.5<br>CO-581-B | Advanced Production System Design | Lecture | 2.5</td></tr>
<tr><td colspan="2">Module Coordinator<br><br>Prof. Dr. Yilmaz Uygun</td><td colspan="2">Program Affiliation<br><br>• Industrial Engineering & Management (IEM)</td><td colspan="2">Mandatory Status<br><br>Mandatory for IEM</td></tr>
<tr><td colspan="3">Entry Requirements<br><br>Pre-requisites<br>☒ General Industrial Engineering<br><br>Co-requisites<br>☒ None<br><br>Knowledge, Abilities, or Skills<br>• Basic spreadsheet software skills (e.g. MS Excel)</td><td>Frequency<br><br>Annually (Fall)<br><br>Duration<br><br>2 semesters</td><td colspan="2">Forms of Learning and Teaching<br><br>• Lectures (17.5 hours)<br>• Labs (17.5 hours)<br>• Group work (45 hours)<br>• Private study (45 hours)<br><br>Workload<br><br>125 hours</td></tr>
<tr><td colspan="6">Recommendations for Preparation<br><br>Revise the material from the General Industrial Engineering module on technical drawings and production system design.</td></tr>
<tr><td colspan="6">Content and Educational Aims<br><br>The first module component, "Fundamentals of Engineering Design", will continue the basics taught in the General IEM module regarding technical drawing and sketching. Students will learn how to use CAx, computer-aided technologies, that aid in the design, analysis, and manufacture of products. Through exercises that include sketching (both manually and virtually) and creating simple prototypes, students will learn how to apply methods for 3D modelling software (e.g. Onshape). Moreover, students will use an Engineering Journal in order to learn to keep an organized record of their engineering drawings and prototypes.<br><br>The module component "Advanced Production System Design" will introduce students to advanced methods of production system design. The lecture combines theoretical knowledge and hands-on exercises. Students will be introduced to different production organization forms in different industries. Students learn to analyze products, calculate the required number of machines, cluster those to machine groups, determine space requirements, lay them out, and design work stations with the Methods-Time Measurement (MTM) technique.</td></tr>
</table>

*Intended Learning Outcomes*

By the end of this module, students will be able to

- become familiar with the design process and learn creative approaches to problem solving;
- produce 3D modelling parts, assemblies, and technical drawings using a 3D modeling software;
- become proficient in record keeping through the use of an Engineering Journal;
- apply CAx systems to design simple product prototypes;
- analyze product portfolios as to their cost structures and profit contribution using clustering techniques (e.g., ABC, XYZ)
- calculate the required number of machines for a given scope of manufacturing requirements;
- cluster and define machine groups using clustering techniques;
- design a proper layout for the selected machines;
- design a manual workstation using the MTM method.

*Indicative Literature*

Hopp, W.J. & Spearman, M.L. (2011).Factory Physics. 3rd Edition, Waveland Publishing.

Architecture Technology Corp (1991). Computer Aided Process Planning (CAPP), Elsevier Advanced Technology.

Altintas, Y. (2012). Manufacturing automation metal cutting mechanics, machine tool vibrations, and CNC design, Cambridge University Press.

Groover, M. (1996). Fundamentals of modern manufacturing, Wiley.

*Usability and Relationship to other Modules*

- Mandatory for a major in IEM
- Mandatory for a minor in IEM
- Pre-requisite for 3rd-year IEM Specialization modules and Thesis
- Elective for all other undergraduate study programs.
- The module builds on the 1st-year IEM CHOICE module General Industrial Engineering.

*Examination Type: Module Component Examinations*

Component 1: Lab

Assessment Type: Project — Weight: 50%
Scope: Intended learning outcomes 1-4 of the module

Component 2: Lecture

Assessment Type: Written Examination — Duration: 90 minutes, Weight: 50%
Scope: Intended learning outcomes 5-9 of the module

Completion: To pass this module, the examination of each module component has to be passed with at least 45%

## 7.7 Production Planning & Control

<table>
<tr><td colspan="2">Module Name<br><br>Production Planning and Control</td><td>Module Code<br><br>CO-580</td><td>Level (type)<br><br>Year 2 (CORE)</td><td>CP<br><br>5</td></tr>
<tr><td colspan="5">Module Components<br><br>Number Name Type CP</td></tr>
<tr><td>CO-580-A</td><td colspan="2">Production Planning and Control</td><td>Lecture</td><td>5</td></tr>
<tr><td>Module Coordinator<br><br>Prof. Dr.-Ing. Hendro Wicaksono</td><td colspan="2">Program Affiliation<br><br>• Industrial Engineering & Management (IEM)</td><td colspan="2">Mandatory Status<br><br>Mandatory for IEM</td></tr>
<tr><td colspan="2">Entry Requirements<br><br>Pre-requisites<br><br>☒ General Logistics</td><td>Co-requisites<br><br>☒ None</td><td>Knowledge, Abilities, or Skills<br><br>• Basic spreadsheet software skills (e.g. MS Excel)</td><td>Frequency<br><br>Annually (Spring)<br><br>Duration<br><br>1 semester</td><td>Forms of Learning and Teaching<br><br>• Lecture (35 hours)<br>• Private Study (90 hours)<br><br>Workload<br><br>125 hours</td></tr>
<tr><td colspan="5">Recommendations for Preparation<br><br>Hopp, W. J. & Spearman, M. L., Factory Physics: Foundations of Manufacturing Management, 3rd edition, Waveland Press Inc., 2011.<br><br>Jacobs, F. R. & Chase, R. C., Operations and Supply Chain Management, 15th edition, McGraw-Hill, 2018.</td></tr>
<tr><td colspan="5">Content and Educational Aims<br><br>A thorough introduction of the planning and control basics and their coherences with the essential processes of the order management within production companies as well as the co-ordination of the entire manufacturing processes will be given in this lecture. The module presents the problems that production companies are confronted with. Further, students gain a profound understanding of the objectives of production logistics, the modeling methods of production systems, and the production planning and control (PPC) tasks, i.e. demand forecasting, capacity planning, aggregate and workforce planning, material requirement planning, lot sizing, sequencing and scheduling, shop floor control, and production tracking. Various mathematical and statistical methods are integrated in this lecture. Furthermore, new production requirements, such as green production, and mass customization and their impacts on PPC tasks will be discussed.</td></tr>
<tr><td colspan="5">Intended Learning Outcomes<br><br>By the end of this module, students will be able to<br><br>• explain the objectives of production systems, their trade-offs, and the role of production planning and control (PPC);<br>• apply production planning and control (PPC) frameworks, including activities such as forecasting, capacity, workforce, aggregate planning, scheduling and sequencing, shop floor control, and production tracking;<br>• apply mathematical and statistical methods, such as linear programming, linear regression, decision tree, etc., to solve production planning and control problems;<br>• independently develop concepts to apply new technologies to improve PPC activities;</td></tr>
</table>

- demonstrate the impacts of new production requirements on PPC activities, such as green production and lot size one production;
- give an outlook on the trends of PPC and the roles of IT systems.

*Indicative Literature*

Hopp, W. J. & Spearman, M. L. (2001). Factory Physics: Foundations of Manufacturing Management, 3rd edition, Waveland Press Inc.

Jacobs, F. R. & Chase, R. C. (2018). Operations and Supply Chain Management, 15th edition, McGraw-Hill.

*Usability and Relationship to other Modules*

- Mandatory for a major in IEM
- Mandatory for a minor in IEM
- Pre-requisite for 3rd-year IEM Specialization modules and Thesis
- Elective for all other undergraduate study programs.
- The module builds on the 1st-year IEM CHOICE module Introduction to Logistics & Supply Chain Management.
- The module builds on the 1st-year IEM CHOICE module General Logistics.

*Examination Type: Module Examination*

Assessment Type: Written examination

Duration: 120 minutes
Weight: 100 %

Scope: All intended learning outcomes of the module

## 7.8 Operations Research

<table>
<tr><td colspan="3">Module Name<br><br>Operations Research</td><td>Module Code<br><br>CO-583</td><td>Level (type)<br><br>Year 2 (CORE)</td><td>CP<br><br>5</td></tr>
<tr><td colspan="6">Module Components<br><br>Number | Name | Type | CP<br>CO-583-A | Operations Research | Lecture | 5</td></tr>
<tr><td>Module Coordinator<br><br>Prof. Dr. Marcel Oliver</td><td colspan="3">Program Affiliation<br><br>• Industrial Engineering & Management (IEM)</td><td colspan="2">Mandatory Status<br><br>Mandatory for IEM<br><br>Mandatory elective for IMS</td></tr>
<tr><td colspan="3" rowspan="2">Entry Requirements<br><br>Pre-requisites<br>☒ None<br><br>Co-requisites<br>☒ None<br><br>Knowledge, Abilities, or Skills<br>• Basic spreadsheet software skills (e.g. MS Excel)<br>• basic calculus and matrix algebra<br>• basic knowledge in logistics</td><td>Frequency<br><br>Annually (Fall)</td><td colspan="2">Forms of Learning and Teaching<br><br>• Lectures (35 hours)<br>• Private Study (90 hours)</td></tr>
<tr><td>Duration<br><br>1 semester</td><td colspan="2">Workload<br><br>125 hours</td></tr>
<tr><td colspan="6">Recommendations for Preparation<br><br>Revise basic calculus, matrix algebra and spreadsheet software functions.</td></tr>
<tr><td colspan="6">Content and Educational Aims<br><br>Operations research is an interdisciplinary mathematical science that focuses on the effective use of technology by organizations. By employing techniques such as mathematical modeling, statistical analysis, and mathematical optimization, operations research finds optimal or near-optimal solutions to complex decision-making problems. Operations Research is concerned with determining the maximum (of profit, performance, or yield) or the minimum (of loss, risk, or cost) of some real-world objective. This module introduces students to the modelling of decision problems and the use of quantitative methods and techniques for effective decision-making.</td></tr>
<tr><td colspan="6">Intended Learning Outcomes<br><br>By the end of this module, students will be able to<br><br>• calculate optimal or near-optimal solutions to complex decision-making problems using operations research methods;<br>• design mathematical models for business problems;<br>• apply techniques such as linear programming, dynamic programming or stochastic programming to solve business problems;<br>• resolve common network optimization problems such as transportation, shortest path, minimum spanning tree, and maximum flow problems.</td></tr>
<tr><td colspan="6">Indicative Literature<br><br>Hillier, F. S. & Lieberman, G.J. (2009). Introduction to Operations Research. McGraw-Hill. New York, NY.</td></tr>
</table>

*Usability and Relationship to other Modules*

- Pre-requisite for 3rd-year IEM Specialization modules and Thesis
- Serves as a 3rd-year Specialization module for major students in IMS
- Elective for all other undergraduate study programs.

*Examination Type: Module Examination*

Assessment Type: Written examination

Duration: 120 minutes
Weight: 100 %

Scope: All intended learning outcomes of the module.

## 7.9 Lean Supply Management

<table>
<tr><td colspan="3">Module Name<br><br>Lean Supply Management</td><td>Module Code<br><br>CO-584</td><td>Level (type)<br><br>Year 2 (CORE)</td><td>CP<br><br>5</td></tr>
<tr><td colspan="6">Module Components<br><br>Number | Name | Type | CP</td></tr>
<tr><td>CO-584-A</td><td colspan="3">Advanced Lean Methods</td><td>Seminar</td><td>2.5</td></tr>
<tr><td>CO-584-B</td><td colspan="3">Purchasing & Supply Management</td><td>Seminar</td><td>2.5</td></tr>
<tr><td colspan="2">Module Coordinator<br><br>Dr. Stanislav Chankov</td><td colspan="2">Program Affiliation<br><br>• Industrial Engineering & Management (IEM)</td><td colspan="2">Mandatory Status<br><br>Mandatory for IEM students</td></tr>
<tr><td colspan="3">Entry Requirements<br><br>Pre-requisites<br><br>☒ General Industrial Engineering, General Logistics, Introduction to International Business<br><br>Co-requisites<br><br>☒ None<br><br>Knowledge, Abilities, or Skills<br><br>☒ None</td><td>Frequency<br><br>Annually<br><br>(Fall)<br><br>Duration<br><br>2 semesters</td><td colspan="2">Forms of Learning and Teaching<br><br>• Seminars (35 hours)<br>• Private Study (90 hours)<br><br>Workload<br><br>125 hours</td></tr>
<tr><td colspan="6">Recommendations for Preparation<br><br>Revise material from the 1st year related to lean methods and purchasing.</td></tr>
<tr><td colspan="6">Content and Educational Aims<br><br>The module consists of two module components. The first module component, Advanced Lean Methods, gives a micro perspective focused on a company's processes and decisions. The second module component, Purchasing & Supply Management, provides a macro perspective of the market and how the decision of one supplier can affect the rest of the supply chain, prices, and even demand. Both module components complement students' knowledge regarding processes, inside and outside of a company respectively.<br><br>The first module component, Advanced Lean Methods deals with the implementation and amplification of 20th-century lean methods in modern manufacturing processes associated with the kaizen philosophy. These include change management process, elimination of waste, one piece flow, pull principle, value stream mapping, 6 sigma, and zero defects. The module component provides a theoretical overview of these methods and enables students to apply them in practice by participating in game-based activities in class. The module component is heavily focused on the applicability of lean methods, providing numerous examples from the industry. Specifically, students apply the value stream mapping method to a real-world case study.<br><br>The second module component, Purchasing & Supply Management deals with purchasing and supply management practices. The costs of procuring materials or services can represent a large portion of an enterprise's total costs. Hence, purchasing and supply management are of crucial importance for the overall success of the company. In this module component, students learn via case studies how to develop the right purchasing strategy for each material segment and how to select the right supplier for each material. Other topics include behavioral aspects of purchasing, negotiation, buyer–supplier relationships, supplier integration, supplier quality management, working capital management, and innovation sourcing.</td></tr>
</table>

*Intended Learning Outcomes*

By the end of this module, students will be able to:

- evaluate as-is processes and suggest improvements based on the kaizen philosophy
- identify different waste types in industrial processes and identify ways to eliminate the waste;
- explain main lean methods;
- apply value stream mapping to industrial processes;
- develop a sourcing strategy for specific material categories;
- explain how behavioral aspects play a role in buyer-supplier interactions;
- design a negotiation strategy based on buyer-supplier power positioning;
- apply quality management methods to ensure good supplier quality.

*Indicative Literature*

Benton, W. C. (2013). Purchasing and Supply Chain Management: Third Edition. McGraw-Hill Higher Education (McGraw-Hill/Irwin series operations and decision sciences).

Monczka, R. M. et al. (2015). Purchasing and Supply Chain Management. Cengage Learning.

Ohno, T. (1988). Toyota Production System: Beyond Large-Scale Production. Boca Raton, FL: Taylor & Francis (Productivity Press).

Womack, J. P., Jones, D. T. and Roos, D. (2007). The Machine That Changed the World: The Story of Lean Production-- Toyota's Secret Weapon in the Global Car Wars That Is Now Revolutionizing World Industry. Free Press.

*Usability and Relationship to other Modules*

- Mandatory for a major in IEM
- Pre-requisite for 3rd-year IEM Specialization modules and Thesis
- Elective for all other undergraduate study programs.

*Examination Type: Module Component Examinations*

Component 1: Seminar 1

Assessment Type: Written examination — Duration: 60 minutes, Weight: 50 %

Scope: Intended learning outcomes 1-4 of the module.

Component 2: Seminar 2

Assessment Type: Term paper — Length: 2.000 words, Weight: 50 %

Scope: Intended learning outcomes 5-8 of the module.

Completion: To pass this module, the examination of each module component has to be passed with at least 45%

## 7.10 Production & Technology Management

<table>
<tr><td colspan="2">Module Name<br><br>Production and Technology Management</td><td>Module Code<br><br>CO-585</td><td>Level (type)<br><br>Year 2 (CORE)</td><td>CP<br><br>5</td></tr>
<tr><td colspan="5">Module Components<br><br>Number Name Type CP</td></tr>
<tr><td>CO-585-A</td><td colspan="2">Production and Technology Management</td><td>Lecture</td><td>5</td></tr>
<tr><td>Module Coordinator<br><br>Prof. Dr.-Ing. Hendro Wicaksono</td><td colspan="2">Program Affiliation<br><br>• Industrial Engineering & Management (IEM)</td><td colspan="2">Mandatory Status<br><br>Mandatory for IEM</td></tr>
<tr><td colspan="2">Entry Requirements<br><br>Pre-requisites ☒ General Logistics<br>Co-requisites ☒ None<br>Knowledge, Abilities, or Skills ☒ None</td><td>Frequency<br><br>Annually (Spring)<br><br>Duration<br><br>1 semester</td><td colspan="2">Forms of Learning and Teaching<br><br>• Lecture (35 hours)<br>• Private Study (90 hours)<br><br>Workload<br><br>125 hours</td></tr>
<tr><td colspan="5">Recommendations for Preparation<br><br>Tidd, J. and Bessant, J, Managing Innovation: Integrating Technological, Market and Organizational Change, Wiley, 2013</td></tr>
<tr><td colspan="5">Content and Educational Aims<br><br>The module discusses the current challenges and context faced by companies in providing products and services including production and logistics. Then, the module focuses on the trends of production and logistics and how disruptive technologies, such as the internet of things, cloud computing, and big data provide new contexts of production logistics. The trends discussed include the factory of the future, additive manufacturing, sustainable manufacturing, mass customization, and future working systems. In order to prepare themselves for competition due to these new contexts, companies need to be innovative in providing products and services. This module also gives insights how innovations and technologies are managed and implemented for new products and services. Knowledge and data, which are the key enabler of innovation in an organization, have to be also managed. This lecture introduces the methods and tools for data and knowledge management. Furthermore, business process model development, which leads products and services to market, will be also discussed.<br><br>The project work will cover case studies in modern companies. The case studies discuss why and how firms introduce new technologies in their production and logistics processes, how they manage their innovation and technologies, how they manage knowledge, and what kind of new products or services they can provide.</td></tr>
</table>

*Intended Learning Outcomes*

By the end of this module, students will be able to:

- describe the challenges and contexts of current production and logistics, and list and describe the roles of disruptive technologies in production and logistics;
- explain how production and logistic processes will look like in the future (e.g., factory of the future, sustainable manufacturing, mass customization) and the role of new technologies;
- distinguish between different types of innovations, explain where the innovations come from, and describe the methods and tools for managing innovation and technologies;
- explain the knowledge sources, the processes and steps in knowledge management, and the required tools;
- describe how innovations become new products or services and what are the corresponding business models;
- apply the discussed topics to case studies;
- carry out a project including analysis and structuring cases, literature review, project and time management, team work, scientific writing, and scientific presentation.

*Indicative Literature*

Tidd, J. and Bessant, J, (2013). Managing Innovation: Integrating Technological, Market and Organizational Change, Wiley.

*Usability and Relationship to other Modules*

- Mandatory for a major in IEM.
- Pre-requisite for 3rd-year IEM Specialization modules and Thesis.
- Elective for all other undergraduate study programs.
- The module builds on the 1st-year IEM CHOICE module General Logistics.

*Examination Type: Module Examination*

Assessment Type: Project (group assessment) Weight: 100%

Scope: All intended learning outcomes of the module.

## 7.11 Applied Project Management

| *Module Name* | *Module Code* | *Level (type)* | *CP* |
|---|---|---|---|
| Applied Project Management | CO-600 | Year 2 (Choice) | *7.5* |

*Module Components*

| *Number* | *Name* | *Type* | *CP* |
|---|---|---|---|
| CO-600-A | Applied Project Management - Lecture | Lecture | 5 |
| CO-600-B | Applied Project Management - Seminar | Seminar | 2.5 |

| *Module Coordinator* | *Program Affiliation* | *Mandatory Status* |
|---|---|---|
| Prof. Dr.-Ing. Steffen Christoph Eickemeyer | • International Business Administration (IBA) | Mandatory Elective for IBA, mandatory for IEM |

| *Entry Requirements* | | | *Frequency* | *Forms of Learning and Teaching* |
|---|---|---|---|---|
| *Pre-requisites* | *Co-requisites* | *Knowledge, Abilities, or Skills* | Annually (Fall) | • Lecture (35 hours)<br>• Seminar (17.5 hours)<br>• Private Study (135 hours) |
| ☒ Introduction to Internatioanal Business and Introduction to Finance and Accounting | ☒ None | • None | *Duration*<br>1 semester | *Workload*<br>187.5 hours |

*Recommendations for Preparation*

Before the first session, students should read: Luecke, R. (2004) : Managing Projects Large and Small - The Fundamental Skills for Delivering on Budget and on Time, Harvard Business School Press.

Course Description / Content / Aims

Well-run projects depend entirely on the foundation laid in the initial planning stages, the care and precision of project organization, and excellent teamwork. The module Applied Project Management *(APM)* offers a detailed look at the characteristics of projects and a hands-on team simulation of the project planning and management process.

The APM module explains various project phases, including major and detailed tasks. It will deal with task assignment and resource allocation, budgeting, tracking, and scheduling techniques as well as with project leadership and team processes. The course will give students hands-on experience with project management, as students have to run a project on their own in teams over the semester.
The lecture component of this module covers the theoretical basics and offers practical examples. The seminar component of this module serves as an exercise based on examples and case studies, which are also carried out over the course hours in homework.

*Intended Learning Outcomes*
By the end of this module, students should be able to

- identify and memorize the key skills to manage projects, including internationally accepted standards and procedures for runing and controling projects;
- apply project management skills to set up, organize, manage and control (real) projects;
- analyze project performance;
- develop strong analytical and presentation skills.

*Indicative Literature*

Bittner, E., Gregorc, W. (ed.) (2010). Experiencing Project Management: Projects, Challenges and Lessons Learned. Hoboken: John Wiley & Sons.

Larson, E. W., Gray, C. F. (2015). A guide to the project management body of knowledge: PMBOK (®) guide. In: Project Management Institute.

Luecke, R (2004). Managing projects large and small: the fundamental skills for delivering on budget and on time. Harvard: Harvard Business Press.

Marks, T. (2012). 20:20 Project Management: How to deliver on time, on budget and on spec. London: Kogan Page Publishers.

Larson, E.W.; Gray, C. (2017). Project management: the managerial process, 7th edition. New York: McGraw-Hill Education.

Moriis, P.W.G., Pinto, J. K, Söderland, Jonas (Hg.) (2012). The Oxford handbook of project management. Oxford: Oxford University Press.

Pries, K. H.; Quigley, J.M (2010). Scrum project management. Boca Raton: CRC press.

*Usability and Relationship to other Modules*

- Mandatory elective module for a major in IBA
- Mandatory for a minor in IBA
- Mandatory for a major in IEM

*Examination Type: Module Examination*

Assessment Type: Presentation — Duration: 45 minutes, Weight: 100%

Scope: All intended learning outcomes

## 7.12 International Strategic Management

<table>
<tr><td colspan="3">Module Name<br>International Strategic Management</td><td>Module Code<br>CO-601</td><td>Level (type)<br>Year 2 (CORE)</td><td>CP<br>7.5</td></tr>
<tr><td colspan="6">Module Components<br><br>Number | Name | Type | CP<br>CO-601-A | International Strategic Management - Lecture | Lecture | 5<br>CO-601-B | International Strategic Management - Seminar | Seminar | 2.5</td></tr>
<tr><td>Module Coordinator<br><br>Prof. Dr. Tilo Halaszovich</td><td colspan="3">Program Affiliation<br><br>• International Business Administration (IBA)</td><td colspan="2">Mandatory Status<br><br>Mandatory elective for IBA<br>Mandatory for IEM</td></tr>
<tr><td colspan="3">Entry Requirements<br><br>Pre-requisites<br>☒ Introduction to International Business and Introduction to Finance and Accounting<br><br>Co-requisites<br>☒ None<br><br>Knowledge, Abilities, or Skills<br>• Academic writing skills<br>• Good understanding of the principles of international management</td><td>Frequency<br><br>Annually (Spring)<br><br>Duration<br><br>1 semester</td><td colspan="2">Forms of Learning and Teaching<br><br>• Lecture (35 hours)<br>• Seminar (17.5 hours)<br>• Private Studies (135 hours)<br><br>Workload<br><br>187.5 hours</td></tr>
<tr><td colspan="6">Recommendations for Preparation<br><br>Students should have developed a sound understanding of the principles of international management. In this advanced module, these principles are not repeated but are used as a basis. It is strongly recommended for all students to refresh their knowledge of the CHOICE module Introduction to International Business.</td></tr>
<tr><td colspan="6">Content and Educational Aims<br><br>This module will explore the nature of strategy, the forces of competition and strategic decision-making in a globalized world. The module covers the principles of both business-level and corporate-level strategies in international organizations. It is designed to introduce a wide variety of modern strategy frameworks and methodologies, including methods of assessing the attractiveness of foreign markets, and the strength of competition, for understanding relative bargaining power, for anticipating competitors' actions, and for analyzing cost and value structures in global supply chains.<br><br>The lecture part of this module conveys the relevant concepts and theories of international strategic management in an interactive manner. In the seminar part, students will apply this knowledge to real world challenges in international strategic management.</td></tr>
<tr><td colspan="6">Intended Learning Outcomes<br><br>By the end of this module, students should be able to<br>• identify and explain critical challenges in strategic management;<br>• develop a sound understanding of the mechanisms behind international strategic assessments and planning processes;<br>• evaluate and design strategies in international management, such as market selection or entry mode choices;<br>• acquire and develop t additional knowledge and skills needed to support strategic decision making in international firms;<br>• utilize analytical skills and apply relevant tools as required in the discipline.</td></tr>
<tr><td colspan="6">Indicative Literature</td></tr>
</table>

Verbeke, A. (2013). International Business Strategy – 2nd edition. Cambridge: Cambridge: University Press.

Morschett, D., Schramm-Klein, H. & Zentes, J. (2015). Strategic International Management – 3rd edition. Wiesbaden: Springer Gabler.

*Usability and Relationship to other Modules*

- Mandatory elective for a major in IBA
- Mandatory for a minor in IBA
- Mandatory for a major in IEM
- This module prepares students for the Bachelor Thesis focusing on topics in international management

*Examination Type: Module Examination*

Type: Term Paper Length: 4.000 words

Weight: 100%

Scope: All intended learning outcomes of the module

## 7.13 Guided Industrial Project / Mandatory Internship

<table>
<tr><td colspan="3">Module Name<br>Guided Industrial Project / Mandatory Internship</td><td>Module Code<br>CA-INT-901</td><td>Level (type)<br>Year 3 (Internship)</td><td>CP<br>30</td></tr>
<tr><td colspan="6">Module Components<br><br>Number | Name | Type | CP<br>Ca-901-0 | Internship IEM | Internship | 30</td></tr>
<tr><td>Module Coordinator<br><br>Predrag Tapavicki & Christin Klähn (CSC Organization);<br>SPC / Faculty Startup Coordinator (Academic responsibility);</td><td colspan="3">Program Affiliation<br><br>• Industrial Engineering & Management (IEM)</td><td colspan="2">Mandatory Status<br><br>Mandatory for IEM</td></tr>
<tr><td colspan="3">Entry Requirements<br><br>Pre-requisites<br><br>☒ At least 15 CP from IEM CORE modules<br><br>Co-requisites<br><br>☒ None<br><br>Knowledge, Abilities, or Skills<br><br>• Information provided on CSC pages (see below)<br>• Major specific knowledge and skills</td><td>Frequency<br><br>Annually (Fall)</td><td colspan="2">Forms of Learning and Teaching<br><br>• Internship/Start-up<br>• Internship event<br>• Seminars, info-sessions, workshops and career events<br>• Self-study, readings, online tutorials<br>• IEM internship preparation workshops</td></tr>
<tr><td colspan="3"></td><td>Duration<br>1 semester</td><td colspan="2">Workload<br><br>750 Hours consisting of:<br>• Internship (616 hours)<br>• Workshops (20 hours)<br>• Internship event (2 hours)<br>• Self-study (112 hours)</td></tr>
<tr><td colspan="6">Recommendations for Preparation<br><br>• Reading the information in the menu sections “Internship Information”, “Career Events”, “Create Your Application” and “Seminars & Workshops” at the Career Services Center website http://csc-microsite.user.jacobs-university.de/<br>• Completing all four online tutorials about job market preparation and the application process ( http://csc-microsite.user.jacobs-university.de/create-your-application/tutorials/)<br>• Participation in the Internship Events of earlier classes</td></tr>
<tr><td colspan="6">Content and Educational Aims<br><br>The aims of the internship module are reflection, application, orientation, and development. Students can reflect on their interests, knowledge, skills, their role in society, the relevance of their major subject in society;</td></tr>
</table>

apply these skills and knowledge in real life while obtaining practical experience; find their professional orientation; and develop their personality and career. The module supports the programs' aims of preparing students for gainful, qualified employment and the development of their personality.

The full-time internship must be related to industrial engineering and management and extends over a minimum period of four consecutive months, normally scheduled in the fifth semester, with the internship event and submission of the internship report in the sixth semester. The Study Program Coordinator or their faculty delegate approves the intended internship by reviewing the tasks in either the Internship Contract or Internship Confirmation from the respective internship institution or company. Further regulations as set out in the Policies for Bachelor Studies apply.

The internship will be gradually prepared in semesters 1 to 4 by a series of mandatory information sessions, seminars, and career events.
The internship will be gradually prepared in semesters 1 to 4 by a series of mandatory information sessions, seminars and career events.
The purpose of the Career Services Information Sessions is to provide all students with basic facts about the job market in general and especially in Germany and the EU, and services provided by the Career Services Center.
In the Career Skills Seminars, students will learn how to engage in the internship/job search, how to create a competitive application (CV, Cover Letter etc.) and how to successfully conduct job interviews and/or assessment centers. In addition to this mandatory part, students can customize their set of skills regarding the application challenges and intended career path in elective seminars.
Finally, during the Career Events organized by the Career Services Center (e.g., the annual Jacobs Career Fair and single employer events on and off campus), students will have the opportunity to apply their acquired job market skills in an actual internship/job search situation and gain a desired internship in a high-quality environment and with excellent employers

In the IEM specialized internship workshops in semesters 1-4, students receive further guidance on how to apply for specific internship positions in the industry.

As an alternative to the full-time internship, students can apply for the StartUp-Option. Following the same schedule as the full-time internship, the StartUp Option allows students who are interested in founding their own company to focus on the development of their business plan over a period of two consecutive months. Participation in the StartUp Option depends on a successful presentation of the initial Startup idea. This presentation will be held at the beginning of the fourth semester. A jury of faculty members will judge the potential to realize the idea and approve the participation of the students. The StartUp Option is supervised by the Faculty StartUp Coordinator. At the end of the StartUp Option, students submit their business plan.
Further regulations as set out in the Policies for Bachelor Studies apply.

The concluding IEM Internship Event will formally conclude the module by providing students the opportunity to present their internships (on posters) and reflect on the lessons learned. The purpose is not only to self-reflect on the whole process but also to create a professional network within the academic community, especially byentering the Alumni Network after graduation. It is recommended that all three classes of the same major are present at this event to enable the creation of networks between older and younger students and to create a learning environment for younger students in the sense of a "lessons learned" effect from the diverse internships of their elder fellow students.

Finally, students are required to examine the economic, social and environmental impacts as well as the ethical implications of the processes within their department or company. Moreover, they are also strongly encouraged to trigger an awareness campaign or to suggest a change to a process in their department or company leading to higher sustainability and/or corporate social responsibility. The main relevant findings and students' reflections are to be included in the internship report and the poster presentation. Thus, the internship module intends to raise awareness of the global challenges of the future and broaden the students' horizon with applied problem solving beyond the borders of their own discipline, preparing them to become informed and responsible citizens in a global society.

*Intended Learning Outcomes*

By the end of this module, students should be able to

- critically analyze industrial problems in a real-world environment;

- create solutions to real industrial situations applying principles of industrial engineering, business administration, strategy, logistics and supply chain management;
- professionally communicate their conclusions and recommendations in both spoken and written form;
- describe the scope and the functions of the employment market and personal career development;
- apply professional, personal, and career-related skills for the modern labor market, including self-organization, initiative and responsibility, communication, intercultural sensitivity, and team and leadership skills;
- independently manage their own career orientation processes: identify personal interests, select appropriate internship destinations or start-up opportunities, conduct interviews, pitches or assessment centers, negotiate related employment, funding or support conditions (such as salary, contract, funding, supplies, work space);
- apply specialist skills and knowledge acquired during their studies to solve problems in a professional environment and reflect on their relevance in employment and society;
- justify professional decisions based on theoretical knowledge and academic methods;
- reflect on their professional conduct in the context of expectations by and consequences for employers and society;
- reflect on and set targets for further development of their knowledge, skills, interests and values;
- establish and expand contacts with potential employers, business partners, and other students and alumni to build their own professional network to create employment opportunities in the future;
- discuss observations and reflections in a professional network;
- critically analyze the economic, social, and environmental impacts as well as the ethical implications of real-world industrial processes with regard to sustainability and corporate social responsibility.

*Indicative Literature*

Not specified

*Usability and Relationship to other Modules*

- This module applies skills and knowledge acquired in previous modules to a professional environment and provides an opportunity to reflect on their relevance in employment and society. It may lead to Thesis topics.

*Examination Type: Module Examination*

Assessment type 1: Internship Report or Business Plan — Length: approx. 3,500 words
Scope: All intended learning outcomes

Assessment type 2: Poster presentation — Duration: 10-15 minutes
Scope: All intended learning outcomes

Two separate assessments are justified by the size of the module and the fact that the justification of solutions to problems and arguments (ILO 6) and discussion (ILO 7) should at least have verbal elements. The weights of the assessments are commensurate with the sizes of the respective module components.

Completion: This module is passed with an assessment-component weighted average grade of 45% or higher.

## 7.14 Industry 4.0 and Blockchain Technologies

<table>
<tr><td colspan="2">Module Name<br><br>Industry 4.0 and Blockchain Technologies</td><td>Module Code<br><br>CA-S-IEM-801</td><td>Level (type)<br><br>Year 3 (Specialization)</td><td>CP<br><br>5</td></tr>
<tr><td colspan="5">Module Components</td></tr>
<tr><td>Number</td><td colspan="2">Name</td><td>Type</td><td>CP</td></tr>
<tr><td>CA-IEM-801-A</td><td colspan="2">Industry 4.0 Technologies</td><td>Lecture</td><td>2.5</td></tr>
<tr><td>CA-IEM-801-B</td><td colspan="2">Blockchain Applications in Industrial Engineering</td><td>Seminar</td><td>2.5</td></tr>
<tr><td>Module Coordinator<br><br>Prof. Dr.-Ing. Hendro Wicaksono</td><td colspan="2">Program Affiliation<br><br>• Industrial Engineering & Management (IEM)</td><td colspan="2">Mandatory Status<br><br>Mandatory elective for IEM</td></tr>
<tr><td colspan="3" rowspan="2">Entry Requirements<br><br>Pre-requisites<br><br>☒ Production and Technology Management<br><br>Co-requisites<br><br>☒ None<br><br>Knowledge, Abilities, or Skills<br><br>☒ None</td><td>Frequency<br><br>Annually (Spring)</td><td>Forms of Learning and Teaching<br><br>• Lecture (17.5 hours)<br>• Seminar (17.5 hours)<br>• Private Study and Project Work (90 hours)</td></tr>
<tr><td>Duration<br><br>1 semester</td><td>Workload<br><br>125 hours</td></tr>
<tr><td colspan="5">Recommendations for Preparation<br><br>Learn or practice basic functions in SQL database.</td></tr>
<tr><td colspan="5">Content and Educational Aims<br><br>In the "Industry 4.0 Technologies" module component, industry 4.0, a concept coined by the German Federal Government that refers to the fourth industrial revolution, will be introduced. Industry 4.0 is characterized by the interlinking of industrial production with modern information and communication technologies, such as the internet of things, big data, and augmented/virtual/mixed reality. This module aims to provide exposure to a range of information and communication technologies currently applied to support production and logistics processes. Afterwards, the core Industry 4.0 technologies and their technical, business, and ethical impacts will be introduced. The students will work on a group case study project to analyze the applications and impacts of industry 4.0-related technologies in different sectors, such as manufacturing, logistics, agriculture, and construction.<br><br>In the "Blockchain Applications in Industrial Engineering" module component, students will learn and experience the blockchain approach. The potential of blockchain technology for the field of industrial engineering will be discussed and different blockchain applications in this field will be presented. This module covers private blockchains (i.e., applications in industrial engineering) and public blockchains (e.g., token-based blockchains and cryptocurrencies). During the module, a project will be carried out covering the design, development, and implementation of a blockchain simulation. With the support of the lecturer, the students create a simulation on a pen-and-paper basis. The simulation follows the game-based learning principle so that the students experience the concept of the blockchain approach and its application.</td></tr>
</table>

*Intended Learning Outcomes*

By the end of this module, students will be able to

- explain the motivation, development history, and core technologies of industry 4.0;
- distinguish between the roles of technical and business information systems;
- distinguish and give examples of functions covered by different information systems;
- explain the infrastructure and technologies required for industry 4.0 and the resulting improvements;
- assess the possible business models, environmental, social, and ethical impacts of industry 4.0 applications.
- explain the blockchain approach, including the basic concepts of cryptography and smart contracts;
- discuss the challenges, advantages, and disadvantages of private and public blockchains;
- analyze different consensus algorithms and demonstrate their advantages and disadvantages;
- illustrate different applications of the blockchain approach in the field of Industrial engineering (e.g., production, logistics, and finance);
- design and implement a blockchain simulation;

*Indicative Literature*

Drescher, D. (2017). Blockchain Basics: A Non-Technical Introduction in 25 Steps. Apress.

Hosp J. (2017). Cryptocurrencies Simply Explained. Julian Hosp Coaching LTD.

Narayanan, A., Bonneau, J., Felten, E. Miller, A., Goldfeder, S. (2016). Bitcoin and Cryptocurrency Technologies. Princeton University Press (Draft version: http://bitcoinbook.cs.princeton.edu/).

Sendler, U., Wawer V. (2008). CAD and PDM : Optimizing Proccesses by Integrating Them CAD und PDM, Hanser Verlag Muniche Vienna, ISBN: 978-3-446-41327-6 ; 3-446-41327-8.

Kale, V. (2016). Enhancing Enterprise Intelligence: Leveraging ERP, CRM, SCM, PLM, BPM, and BI, CRC Press.

Alp Ustundag, Emre Cevikcan, Industry 4.0.: Managing The Digital Transformation, Springer, 2017, ISBN 978-3-319-57870-5

Gronwald, K.-D. (2017). Integrated Business Information Systems A Holistic View of the Linked Business Process Chain ERP-SCM-CRM-BI-Big Data, Springer, ISBN 978-3-662-53291-1.

*Usability and Relationship to other Modules*

- Mandatory elective specialization module for 3rd year IEM major students
- Elective for all other undergraduate study programs

*Examination Type: Module Examination*

Assessment Type: Project (Group Assessment) Weight 100%

Scope: All intended learning outcomes of the module.

## 7.15 Advanced Product Design

<table>
<tr><td colspan="3">Module Name<br><br>Advanced Product Design</td><td>Module Code<br><br>CA-S-IEM-802</td><td>Level (type)<br><br>Year 3 (Specialization)</td><td>CP<br><br>5</td></tr>
<tr><td colspan="6">Module Components</td></tr>
<tr><td>Number</td><td colspan="3">Name</td><td>Type</td><td>CP</td></tr>
<tr><td>CA-IEM-802</td><td colspan="3">Advanced Product Design</td><td>Lab</td><td>5.0</td></tr>
<tr><td>Module Coordinator<br><br>Dr. Stanislav Chankov</td><td colspan="3">Program Affiliation<br><br>• Industrial Engineering & Management (IEM)</td><td colspan="2">Mandatory Status<br><br>Mandatory elective for IEM students</td></tr>
<tr><td colspan="3" rowspan="2">Entry Requirements<br><br>Pre-requisites ☒ Product & Production System Design<br>Co-requisites ☒ None<br>Knowledge, Abilities, or Skills<br>• 3D modelling software</td><td>Frequency<br><br>Annually<br><br>(Spring)</td><td colspan="2">Forms of Learning and Teaching<br><br>• Lab (17.5 hours)<br>• Project Work (45 hours)</td></tr>
<tr><td>Duration<br><br>1 semester</td><td colspan="2">Workload<br><br>125 hours</td></tr>
<tr><td colspan="6">Recommendations for Preparation<br><br>Revise material on CAx systems and 3D modeling software.</td></tr>
<tr><td colspan="6">Content and Educational Aims<br><br>This module provides students with an overview of the technically oriented methodical advances in the engineering field. The focus will not only be on the purely theoretical transfer of knowledge, but theory will be presented in the context of practical examples and exercises to highlight the interaction between knowledge, creativity, and experience. The learned concepts shall be put into practice within the framework of "product development," from the clarification of the requirements through to the development of the product, to manufacturing with a 3D printer. Three main focal points are covered in three sections. The first is methodical product development. This section will convey exemplary methods that will aid the goal-oriented development of a technical product. The second section will present the possibilities that modern CAx systems are offering as well as the potential of a thorough process chain within the product creation. The third section will focus on the various aspects of the construction procedure. This will entail a teamwork project, in which a product will be developed based on the given requirements and restrictions and then constructed using an open-source CAD system.</td></tr>
<tr><td colspan="6">Intended Learning Outcomes<br><br>By the end of this module, students will be able to<br><br>• explain and apply the "product development" framework: from clarification of the requirements, through development of the product, to actual manufacturing with a 3D printer;<br>• apply math, science, and engineering standards to hands-on projects;<br>• utilize designs for the development and production of a final project;<br>• implement problem solving techniques based on specific scenarios;<br>• develop an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, health and safety, manufacturability, and sustainability constraints;</td></tr>
</table>

- develop an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

*Indicative Literature*

Radhakrishnan, P.; Subramanian, S.; Raju, V. (2005). CAD/CAM/CIM , 3rd edition New age international (P), limited publishers.

Schaefer, D. (2014). Cloud-based Design and Manufacturing (CBDM): A Service-Oriented Product Development Paradigm for the 21st Century, Springer.

Nasr A. E.; Kamrani, A. K.; (2007). Computer-Based Design and Manufacturing: An Information-Based Approach, Springer.

Nasr, A. (2007). Computer-Based Design and Manufacturing An Information-Based Approach ,Springer, 2007.

Mitchell, F.H. (1991). CIM Systems: An Introduction to Computer-Integrated Manufacturing", Prentice Hall College Div; 1St Edition edition (January 1991), ISBN: 978-0131332997.

Benhabib, B. (2003). Manufacturing: Design, Production, Automation, and Integration, Marcel Dekker Inc.

*Usability and Relationship to other Modules*

- Elective for: all other undergraduate study programs

*Examination Type: Module Examination*

Assessment Type: Project (group assessment) Weight: 100 %

Scope: All intended learning outcomes of the module.

## 7.16 Supply Chain Design

<table>
<tr><td colspan="3">Module Name</td><td>Module Code</td><td>Level (type)</td><td>CP</td></tr>
<tr><td colspan="3">Supply Chain Design</td><td>CA-S-IEM-803</td><td>Year 3 (Specialization)</td><td>2.5</td></tr>
<tr><td colspan="6">Module Components<br><br>Number Name Type CP</td></tr>
<tr><td>CA-IEM-803</td><td colspan="3">Supply Chain Design</td><td>Seminar</td><td>2.5</td></tr>
<tr><td>Module Coordinator<br><br>Dr. Stanislav Chankov</td><td colspan="3">Program Affiliation<br><br>• Industrial Engineering & Management (IEM)</td><td colspan="2">Mandatory Status<br><br>Mandatory elective for IEM students</td></tr>
<tr><td colspan="3">Entry Requirements<br><br>Pre-requisites Co-requisites Knowledge, Abilities, or Skills<br><br>☒ General Logistics, Lean Supply Management ☒ None ☒ None</td><td>Frequency<br><br>Annually (Spring))<br><br>Duration<br><br>1 semester</td><td colspan="2">Forms of Learning and Teaching<br><br>• Seminars (17.5 hours)<br>• Project Work (45 hours)<br><br>Workload<br><br>62.5 hours</td></tr>
<tr><td colspan="6">Recommendations for Preparation<br><br>Revise material on Logistics and Supply Chain Management.</td></tr>
<tr><td colspan="6">Content and Educational Aims<br><br>This module will bundle theoretical methods for solving industrial problems in logistics networks with practical examples from industry. The tasks and goals of supply chain design, together with methods and instruments for the design of logistics networks, will be presented. Students work intensively in groups on several case studies and are thus able to apply the knowledge they have acquired in their modules and internships on real cases. At the end of the module, students write a paper in groups that investigates a specific supply chain-related problem that a company is facing. They also present the findings in group presentations.</td></tr>
<tr><td colspan="6">Intended Learning Outcomes<br><br>By the end of this module, students will be able to:<br><br>• analyze real-world problems related to supply chain design;<br>• design innovative solutions to existing problems by applying methods for the design of logistics networks on practical cases;<br>• give a presentation on a given problem and derived solution and mange a project under time pressure (basic consulting skills).</td></tr>
<tr><td colspan="6">Indicative Literature<br><br>Watson, M. et al. (2012). Supply Chain Network Design: Understanding the Optimization Behind Supply Chain Design Projects. Aspen Blue Publishing.</td></tr>
<tr><td colspan="6">Usability and Relationship to other Modules</td></tr>
</table>

| |
|---|
| • Mandatory elective specialization module for 3rd-year IEM major students<br>• Elective for all other undergraduate study programs. |
| *Examination Type: Module Examination*<br>Assessment Type: Project (group assessment) Weight: 100 %<br>Scope: All intended learning outcomes of the module. |

## 7.17 Integrated Decision Making in Supply Chain Management

<table>
<tr><td colspan="3">Module Name<br><br>Integrated Decision Making in Supply Chain Management</td><td>Module Code<br><br>CA-S-IEM-804</td><td>Level (type)<br><br>Year 3 (Specialization)</td><td>CP<br><br>2.5</td></tr>
<tr><td colspan="6">Module Components<br><br>Number | Name | Type | CP<br>CA-IEM-804 | Integrated Decision Making in Supply Chain Management | Seminar | 2.5</td></tr>
<tr><td colspan="2">Module Coordinator<br><br>Dr. Stanislav Chankov</td><td colspan="2">Program Affiliation<br><br>• Industrial Engineering & Management (IEM)</td><td colspan="2">Mandatory Status<br><br>Mandatory elective for IEM students</td></tr>
<tr><td colspan="3">Entry Requirements<br><br>Pre-requisites<br>☒ General Logistics, Lean Supply Management<br><br>Co-requisites<br>☒ None<br><br>Knowledge, Abilities, or Skills<br>☒ None</td><td>Frequency<br><br>Annually (Spring)<br><br>Duration<br><br>1 semester</td><td colspan="2">Forms of Learning and Teaching<br><br>• Seminars (17.5 hours)<br>• Project Work (45 hours)<br><br>Workload<br><br>62.5 hours</td></tr>
<tr><td colspan="6">Recommendations for Preparation<br><br>Familiarize yourself with the Fresh Connection game and the basics of fruit juice production and distribution.<br><br>Revise basic concepts from logistics and supply chain management.</td></tr>
<tr><td colspan="6">Content and Educational Aims<br><br>In this module, students play the Fresh Connection game, an innovative web-based business simulation that delivers the ultimate supply chain learning experience. It engages participants in making strategic decisions in the management of a fruit juice manufacturer. Working in teams of four, participants will represent the functional roles of sales, purchasing, supply chain, and operations. They will be confronted with various real-world, real-time dilemmas and render typical supply chain management decisions (e.g., supplier selection, production capacity planning, inventory management). Students learn how to use information in decision-making and how to handle risk and uncertainty, thus experiencing the power of true alignment and a well-articulated supply chain strategy, supported by tactical skills and knowledge.</td></tr>
<tr><td colspan="6">Intended Learning Outcomes<br><br>By the end of this module, students will be able to<br><br>• formulate and explain supply chain strategies;<br>• make decisions in a high-pressure environment as part of a team considering conflicting logistics targets;<br>• evaluate different suppliers and defend appropriate contract terms in a global supply chain environment;<br>• design appropriate techniques for capacity planning in warehouses and production, inventory management, and demand forecasting;<br>• analyze the environmental impact of a given supply chain and suggest sustainability improvements;<br>• develop project management tools to effectively work in teams to perform a task.</td></tr>
</table>

*Indicative Literature*

Weenk, E. (2019). Mastering the Supply Chain: Principles, Practice and Real-Life Applications. Kogan Page.

*Usability and Relationship to other Modules*

- Mandatory elective specialization module for 3rd-year IEM major students
- Elective for all other undergraduate study programs.

*Examination Type: Module Examination*

Assessment Type: Project (group assessment) Weight: 100 %

Scope: All intended learning outcomes of the module.

## 7.18 Distribution & E-commerce

<table>
<tr><td colspan="3">Module Name<br><br>Distribution & E-Commerce</td><td>Module Code<br><br>CA-S-IEM-805</td><td>Level (type)<br><br>Year 3 (Specialization)</td><td>CP<br><br>2.5</td></tr>
<tr><td colspan="6">Module Components<br><br>Number | Name | Type | CP<br>CA-IEM-805 | Distribution & E-Commerce | Lecture | 2.5</td></tr>
<tr><td colspan="2">Module Coordinator<br><br>Dr. Stanislav Chankov</td><td colspan="2">Program Affiliation<br><br>• Industrial Engineering & Management (IEM)</td><td colspan="2">Mandatory Status<br><br>Mandatory elective for IEM students</td></tr>
<tr><td colspan="3">Entry Requirements<br><br>Pre-requisites<br>☒ Lean Supply Management<br><br>Co-requisites<br>☒ None<br><br>Knowledge, Abilities, or Skills<br>☒ None</td><td>Frequency<br><br>Annually (Spring)<br><br>Duration<br><br>1 semester</td><td colspan="2">Forms of Learning and Teaching<br><br>• Lectures (17.5 hours)<br>• Project Work (45 hours)<br><br>Workload<br><br>62.5 hours</td></tr>
<tr><td colspan="6">Recommendations for Preparation<br><br>Identify major e-commerce companies and read on their distribution strategies and processes.</td></tr>
<tr><td colspan="6">Content and Educational Aims<br><br>This module will introduce the concept of e-commerce and discuss its evolution as a business model and the challenges it brings for traditional distribution logistics. The module will consists of three main parts. The first part will outline the evolution of distribution logistics from direct to store deliveries in the early 1970s up to same-day deliveries and omnichannel supply chains developed by companies. The second part of the module is focused on new operational challenges imposed by e-commerce on the warehousing aspect of distribution logistics, namely the emergence of e-fulfillment centers and the increasing importance of parcel and sorting delivery centers. The last part of the module covers the concepts in last-mile delivery with a focus on different business models (e.g., Amazon, Zalando, Hello Fresh, Uber), the associated challenges for traditional transport, and distribution strategies and novel solution approaches.</td></tr>
<tr><td colspan="6">Intended Learning Outcomes<br><br>By the end of this module, students will be able to<br><br>• explain how new market trends shape traditional operations and distribution logistics;<br>• describe and critically evaluate the evolution of e-commerce, its enablers, and new operational challenges in relation to distribution logistics;<br>• evaluate the various challenges warehouses and sorting centers face in fulfilling e-commerce-specific requirements;<br>• discuss the growing importance and complexity of last-mile deliveries and novel methods to tackle associated delivery problems;<br>• apply theoretical models and frameworks from academic studies to analyze problems in practice;<br>• match different types of operational problems with appropriate (technical) solution approaches;<br>• critically evaluate and working through distribution and e-commerce case studies.</td></tr>
</table>

*Indicative Literature*

A collection of research articles, managerial publications and case studies will be used for this course. The materials will be made available to students two weeks before the beginning of the course.

*Usability and Relationship to other Modules*

- Mandatory elective specialization module for 3rd-year IEM major students
- Elective for all other undergraduate study programs.

*Examination Type: Module Examination*

Assessment Type: Project (group assessment) Weight: 100 %

Scope: All intended learning outcomes of the module.

## 7.19 Law of Transportation, Forwarding and Logistics

<table>
<tr><td colspan="3">Module Name<br><br>Law of Transportation, Forwarding and Logistics</td><td>Module Code<br><br>CA-S-IEM-806</td><td>Level (type)<br><br>Year 3 (Specialization)</td><td>CP<br><br>2.5</td></tr>
<tr><td colspan="6">Module Components<br><br>Number | Name | Type | CP<br>CA-IEM-806 | Law of Transportation, Forwarding and Logistics | Lecture | 2.5</td></tr>
<tr><td colspan="2">Module Coordinator<br><br>Dr. Stanislav Chankov</td><td colspan="2">Program Affiliation<br><br>• Industrial Engineering & Management (IEM)</td><td colspan="2">Mandatory Status<br><br>Mandatory elective for IEM students</td></tr>
<tr><td colspan="3">Entry Requirements<br><br>Pre-requisites | Co-requisites | Knowledge, Abilities, or Skills<br>☒ Lean Supply Management | ☒ None | ☒ None</td><td>Frequency<br><br>Annually (Spring)<br><br>Duration<br><br>1 semester</td><td colspan="2">Forms of Learning and Teaching<br><br>• Lectures (17.5 hours)<br>• Private Study (45 hours)<br><br>Workload<br><br>62.5 hours</td></tr>
<tr><td colspan="6">Recommendations for Preparation<br><br>Familiarize yourself with basic terms of German labor law and international trade law.</td></tr>
<tr><td colspan="6">Content and Educational Aims<br><br>This module deals with the legal aspects of transportation, forwarding, and logistics. After an outline of several aspects of international and national trade law, including the formation of contracts, incorporation of general conditions, and the law of sales contracts, the module focuses on national law on transportation, logistics, and freight forwarding. Thereafter, international conventions on the carriage of goods by sea, air, and land—including multimodal carriage—will be covered. Since logistics is a manifold area, the students will be introduced to the law of warehousing, product assembly, and the handling of dangerous goods in an international context. Focus is placed on the law of other contracts related to transportation and logistics: insurance (marine and liability insurance), agency, construction and long-term contracts, and product liability. The module will end with an outline of international private law (conflicts of law), jurisdiction, litigation, and arbitration.</td></tr>
<tr><td colspan="6">Intended Learning Outcomes<br><br>By the end of this module, students will be able to<br><br>• discuss international trade law in the context of logistics and transportation and international private law;<br>• evaluate contracts for transportation, forwarding and logistics activities;<br>• explain international conventions for the carriage of goods;<br>• analyze legal aspects in contract negotiations for logistics or related contracts.</td></tr>
<tr><td colspan="6">Indicative Literature<br><br>David, P. (2003). International Logistics. Dreamtech Press.</td></tr>
</table>

| |
|---|
| Jané, J. and de Ochoa, A. (2006). The Handbook of Logistics Contracts: A Practical Guide to a Growing Field. Palgrave Macmillan UK. |
| *Usability and Relationship to other Modules*<br>• Mandatory elective specialization module for 3rd-year IEM major students<br>• Elective for all other undergraduate study programs. |
| *Examination Type: Module Examination*<br>Assessment Type: Written examination — Duration: 90 minutes. Weight: 100 %<br>Scope: All intended learning outcomes of the module. |

## 7.20 Bachelor Thesis and Seminar

<table>
<tr><td colspan="3">Module Name<br><br>Bachelor Thesis and Seminar IEM</td><td>Module Code<br><br>CA-IEM-800</td><td>Level (type)<br><br>Year 3 (CAREER)</td><td>CP<br><br>15</td></tr>
<tr><td colspan="6">Module Components<br><br>Number | Name | Type | CP<br>CA-IEM-800-T | Thesis IEM | Thesis | 12<br>CA-IEM-800-S | Thesis Seminar IEM | Seminar | 3</td></tr>
<tr><td colspan="2">Module Coordinator<br><br>Study Program Chair</td><td colspan="2">Program Affiliation<br><br>• Industrial Engineering & Management (IEM)</td><td colspan="2">Mandatory Status<br><br>Mandatory for IEM</td></tr>
<tr><td colspan="3">Entry Requirements<br><br>Pre-requisites<br>☒ None<br><br>Co-requisites<br>☒ None<br><br>Knowledge, Abilities, or Skills<br>• Comprehensive knowledge of the subject and deeper insight into the chosen topic;<br>• ability to plan and undertake work independently;<br>• skills needed to identify and critically review literature.</td><td>Frequency<br><br>Annually (Spring)<br><br>Duration<br><br>1 semester</td><td colspan="2">Forms of Learning and Teaching<br><br>• Self-study/lab work (350 hours)<br>• Seminars (25 hours)<br><br>Workload<br><br>375 hours</td></tr>
<tr><td colspan="6">Recommendations for Preparation<br><br>• Identify an area or a topic of interest and discuss this with your prospective supervisor in a timely manner.<br>• Create a research proposal including a research plan to ensure timely submission.<br>• Ensure you possess all required technical research skills or are able to acquire them on time.<br>• Review the University's Code of Academic Integrity and Guidelines to Ensure Good Academic Practice.</td></tr>
</table>

*Content and Educational Aims*

This module is a mandatory graduation requirement for all undergraduate students. It demonstrates their ability to deal with a problem from their respective major subject independently using academic/scientific methods within a set period. Although supervised, the module requires students to be able to work independently and regularly and set their own goals in exchange for the opportunity to explore a topic that excites and interests them and which a faculty member is interested in supervising. Within this module, students apply their acquired knowledge about the major discipline, skills, and methods for conducting research, including the identification of suitable (short-term) research projects; preparatory literature searches; the realization of discipline-specific research; and the documentation, discussion, interpretation and communication of the results.

This module consists of two components, an independent thesis and an accompanying seminar. The thesis component must be supervised by a Jacobs University faculty member and requires short-term research work, the results of which must be documented in a comprehensive written thesis, including an introduction, a justification of the methods, results, a discussion of the results, and conclusions. The seminar provides students with the opportunity to present, discuss, and justify their and other students' approaches, methods, and results at various stages of their research in order to practice these skills and improve their academic writing and receive and reflect on formative feedback, thereby growing personally and professionally.

Intended Learning Outcomes

*On completion of this module, students should be able to*

1. independently plan and organize advanced learning processes;
2. design and implement appropriate research methods taking full account of the range of alternative techniques and approaches;
3. collect, assess and interpret relevant information;
4. draw scientifically founded conclusions that consider social, scientific and ethical insights;
5. apply their knowledge and understanding to a context of their choice;
6. develop, formulate and advance solutions to problems and arguments in their subject area, and defend these through argument;
7. discuss information, ideas, problems and solutions with specialists and non-specialists.

*Usability and Relationship to other Modules*

- This module builds on all previous modules of the program. Students apply the knowledge, skills and competencies they acquired and practiced during their studies, including research methods and the ability to acquire additional skills independently as and if required.

*Examination Type: Module Component Examinations*

Module Component 1: Thesis
Assessment type: Thesis
Scope: All intended learning outcomes, mainly 1-6.
Weight: 80%
Length: approx. 6.000 – 8.000 words (25 –35 pages), excluding front- and back matter.

Module Component 2: Seminar
Assessment type: Presentation
Duration: approx. 15 to 30 minutes
Weight: 20%

Scope: The presentation focuses mainly on ILOs 6 and 7, but by nature of these ILOs it also touches on the others.

Completion: To pass this module, the examination of each module component has to be passed with at least 45%

Two separate assessments are justified by the size of this module and the fact that the justification of solutions to problems and arguments (ILO 6) and discussion (ILO 7) should at least have verbal elements. The weights of the types of assessments are commensurate with the sizes of the respective module components.

## 7.21 Jacobs Track Modules

### 7.21.1 Methods and Skills Modules

#### 7.21.1.1 Applied Calculus

<table>
<tr><td colspan="3">Module Name<br>Applied Calculus</td><td>Module Code<br>JTMS-MAT-08</td><td>Level (type)<br>Year 1 (Methods)</td><td>CP<br>5</td></tr>
<tr><td colspan="6">Module Components<br><br>Number | Name | Type</td></tr>
<tr><td colspan="3">JTMS-08 | Applied Calculus</td><td colspan="2">Lecture</td><td>5</td></tr>
<tr><td>Module Coordinator<br><br>Marcel Oliver, Tobias Preußer</td><td colspan="3">Program Affiliation<br><br>• Jacobs Track – Methods and Skills</td><td colspan="2">Mandatory Status<br><br>Mandatory for GEM, IBA and IEM<br>Mandatory elective for EES</td></tr>
<tr><td colspan="2">Entry Requirements<br><br>Pre-requisites<br><br>☒ None</td><td><br><br>Co-requisites<br><br>☒ None</td><td><br><br>Knowledge, Abilities, or Skills<br><br>• Knowledge of Mathematics at high school level (Functions, graphs of functions, linear and polynomial functions, logarithms and exponential function, basic trigonometric functions, elementary methods for solving systems of linear and nonlinear equations)<br>• Some familiarity with elementary calculus (limits, derivatives) is helpful, but not required.</td><td>Frequency<br><br>Annually (Fall)<br><br>Duration<br><br>1 semester</td><td>Forms of Learning and Teaching<br><br>• Lectures (35 hours)<br>• Private study (90 hours)<br><br>Workload<br><br>125 hours</td></tr>
<tr><td colspan="6">Recommendations for Preparation<br><br>None.</td></tr>
<tr><td colspan="6">Content and Educational Aims<br><br>This module is an introduction to Calculus for students in life sciences, applied engineering, humanities and social science majors. It gives a broad overview of the methods of Calculus, putting more emphasis on applications, rather than on mathematical rigor. Most of the concepts and methods are backed up by examples from chemistry, biology, economics and/or other sciences. In this module students enhance both their quantitative problem-solving skills as well as their conceptual understanding of mathematical methods.<br><br>The lecture comprises the following topics:<br>• Brief review of elementary functions and their graphs</td></tr>
</table>

- Intuitive understanding of limits; horizontal and vertical asymptotes
- Derivatives and their computation
- Applications of derivatives (interpretation of derivatives, their units, local linear approximation, error propagation, optimization problems)
- Brief introduction to functions of several variables, partial derivatives, local minima and maxima
- Integrals and their computation
- Applications of integrals (accumulated change, average value, applications in probability: density functions and cumulative distribution functions)
- Brief introduction to differential equations.

*Intended Learning Outcomes*

By the end of the module, students will be able to

- apply the fundamental concepts of Calculus in structured situations;
- command the methods described in the content section of this module description to the extent that they can solve standard text-book problems reliably and with confidence;
- explain importance of the methods of Calculus in problems arising from applications;
- understand the methods of Calculus, used in other modules, as well as in scientific literature.

*Indicative Literature*

D. Hughes-Hallett, A. Gleason, P. Lock, D. Flath, et al. (2010/2013). Applied Calculus, 4th or 5th edition. Hoboken: Wiley.

*Usability and Relationship to other Modules*

- The module is a mandatory / mandatory elective module of the Methods and Skills area that is part of the Jacobs Track (Methods and Skills modules; Community Impact Project module; Language modules; Big Questions modules).
- The module serves as preparation for the 2nd year IEM CORE module Operations Research.
- This serves as preparation for the 1st year GEM and IBA modules Microeconomics, Macroeconomics and Introduction to Finance and Accounting
- A mathematically rigorous treatment of Calculus is provided in the module "Analysis I".
- The first year modules *Calculus and Elements of Linear Algebra I+II* can be used in place of the modules *Applied Calculus* and *Finite Mathematics*, respectively, to satisfy the graduation requirements in majors in which they are mandatory.
- Mandatory for GEM, IBA and IEM.
- Mandatory elective for EES.
- Elective for all other study programs.

*Examination Type: Module Examination*

Assessment type: Written examination Duration: 120 min

Weight: 100%

Scope: All intended learning outcomes of this module

## 7.21.1.2 Finite Mathematics

<table>
<tr><td colspan="3">Module Name<br><br>Finite Mathematics</td><td>Module Code<br><br>JTMS-MAT-11</td><td>Level (type)<br><br>Year 1 (Methods)</td><td>CP<br><br>5</td></tr>
<tr><td colspan="6">Module Components<br><br>Number | Name | Type | CP<br>JTMS-11 | Finite Mathematics | Lecture | 5</td></tr>
<tr><td colspan="2">Module Coordinator<br><br>Marcel Oliver, Tobias Preußer</td><td colspan="2">Program Affiliation<br><br>• Jacobs Track – Methods and Skills</td><td colspan="2">Mandatory Status<br><br>Mandatory for IEM</td></tr>
<tr><td colspan="3">Entry Requirements<br><br>Pre-requisites<br><br>☒None<br><br>Co-requisites<br><br>☒ None<br><br>Knowledge, Abilities, or Skills<br><br>The topics in this module are elementary, yet some command of mathematical language is required at a level that corresponds to an upper-level high-school education in mathematics and/or the Jacobs University first-semester modules Mathematical Concepts in the Sciences, Applied Calculus, or Calculus and Elements of Linear Algebra I.</td><td>Frequency<br><br>Annually<br><br>(Spring)<br><br>Duration<br><br>1 semester</td><td colspan="2">Forms of Learning and Teaching<br><br>• Lectures (35 hours)<br>• Private study (90 hours)<br><br>Workload<br><br>125 hours</td></tr>
<tr><td colspan="6">Recommendations for Preparation<br><br>Review -the following topics at high school or elementary university level:<br>• Elementary solution strategies for systems of linear equations<br>• Solution of quadratic equations</td></tr>
</table>

- Factorization of polynomials
- Equations of lines
- Elementary notions of probability

*Content and Educational Aims*

This module is the second semester in a sequence of mathematical methods modules for students in the sciences, industrial engineering, and management majors It aims at rounding off the mathematical education for students in these majors with topics from matrix algebra, probability, and related subjects in a way that is directly useful for the applications in experimental sciences, economics, management, and applied engineering.

The lecture comprises the following topics

- Graphs of lines and planes
- Linear regression and applications
- Systems of linear equations and applications
- Matrix formulation of linear equations, matrix algebra
- Gauss elimination, inverse matrices
- Linear inequalities
- Markov chain
- Sets, counting principles, permutations, combinations
- Sample space, event, probability
- Conditional probability, independence, Bayes' rule with applications
- Expected value, variance, standard deviation
- Binomial distribution and normal distribution
- Elementary descriptive statistics

*Intended Learning Outcomes*

By the end of the module, students will be able to

- apply the methods described in the content section of this module description to the extent that they can solve standard text-book problems reliably and with confidence;
- recognize the mathematical structures in an unfamiliar context and translate them into a mathematical problem statement;
- recognize common mathematical terminology used in textbooks and research papers in science; economics, business, and applied engineering to the extent that they are covered by the content of this module.

*Indicative Literature*

M.L. Lial, R.N. Greenwell, N.P. Ritchey (2015). Finite Mathematics, 11th edition. London: Pearson.

S. Shores (2007). Applied Linear Algebra and Matrix Analysis. Berlin: Springer.

*Usability and Relationship to other Modules*

- The module is a mandatory / mandatory elective module of the Methods and Skills area that is part of the Jacobs Track (Methods and Skills modules; Community Impact Project module; Language modules; Big Questions modules).
- This module serves as a preparation for the 2nd year IEM CORE module Operations Research.
- This module is accessible to all Jacobs students with a minimum of mathematical pre-knowledge and covers a broad range of non-calculus applications of mathematics across a broad spectrum of fields of study
- It most naturally complements the module *Applied Calculus* which covers elementary calculus-based applications of mathematics in a similar spectrum of fields
- There is no strict dependence between *Applied Calculus* and *Finite Mathematics*, but the default recommendation is to take *Applied Calculus* in the first semester and *Finite Mathematics* in the second semester
- Students in majors that require a more advanced mathematics and methods education should consult their program handbooks
- The first year modules *Calculus and Elements of Linear Algebra I+II* can be used in place of the modules *Applied Calculus* and *Finite Mathematics*, respectively, to satisfy the graduation requirements in majors in which they are mandatory.

- Mandatory for major in IEM
- Elective for all other study programs.

*Examination Type: Module Examination*

Assessment type: Written examination Duration: 120 min

Weight: 100%

Scope: All intended learning outcomes of this module

### 7.21.1.3 Programming in Python

<table>
<tr><td colspan="2">Module Name<br><br>Programming in Python</td><td>Module Code<br><br>JTMS-SKI-14</td><td>Level (type)<br><br>Year 1 (Methods)</td><td>CP<br><br>5</td></tr>
<tr><td colspan="5">Module Components<br><br>Number | Name | Type | CP<br>JTMS-14 | Programming in Python | Lecture | 5</td></tr>
<tr><td>Module Coordinator<br><br>Kinga Lipskoch</td><td colspan="2">Program Affiliation<br><br>• Jacobs Track – Methods and Skills</td><td colspan="2">Mandatory Status<br><br>Mandatory for IEM<br><br>Mandatory elective for BCCB, EES and Physics</td></tr>
<tr><td colspan="2">Entry Requirements<br><br>Pre-requisites<br><br>☒ None<br><br>Co-requisites<br><br>☒ None</td><td>Knowledge, Abilities, or Skills<br><br>• none</td><td>Frequency<br><br>Annually<br><br>(Fall)</td><td>Forms of Learning and Teaching<br><br>• Class attendance (35 hours)<br>• Private study (85 hours)<br>• Exam preparation (5 hours)</td></tr>
<tr><td colspan="3"></td><td>Duration<br><br>1 semester</td><td>Workload<br><br>125 hours</td></tr>
<tr><td colspan="5">Recommendations for Preparation<br><br>It is recommended that students install a suitable programming environment (simple editor or Integrated Development Environment) and a new stable version of Python on their notebooks.</td></tr>
<tr><td colspan="5">Content and Educational Aims<br><br>This module offers an introduction to programming using the programming language Python. The module presents the basics of Python programming and provides a short overview of the program development cycle. It covers fundamental programming components and constructs in a hands-on manner. The beginning of the module covers the concepts of data types, variables, operators, strings and basic data structures. Next, other programming constructs such as branching, iterations, and data structures such as strings, lists, tuples, and dictionaries are introduced. The module also gives an introduction to functions, as well as simple file handling by introducing reading data from files, processing the data and writing the results to files. Later, object-oriented programming concepts such as constructors, methods, overloaded operators and inheritance are presented. Retrieving data from URLs and processing of larger amounts of data and their queries and storage in files are addressed. Simple interactive graphics and operations are also presented with the help of an object-oriented graphics library.</td></tr>
</table>

*Intended Learning Outcomes*

By the end of this module, students should be able to

- explain basic concepts of imperative programming languages such as variables, assignments, loops, function calls, data structures;
- work with user input from the keyboard, and write interactive Python programs;
- write, test, and debug programs;
- illustrate basic object-oriented programming concepts such as objects, classes, information hiding, and inheritance;
- give original examples of function and operator overloading;
- retrieve data and process and generate data from/to files;
- use some available Python modules and libraries such as those related to data or graphics.

*Indicative Literature*

Kenneth A. Lambert (2014). Fundamentals of Python Data Structures. Boston: Cengage Learning PTR.

Mark Summerfield (2010). Programming in Python: A complete introduction to the Python language, second edition. London: Pearson Education.

John Zelle (2009). Python Programming: An introduction to Computer Science, second edition. Portland: Franklin, Beedle & Associates.

Igor Milovanovic (2013). Python Data Visualization Cookbook. Birmingham: Packt Publishing.

Cay Horsmann, Rance D. Necaise (2014). Python for Everyone. Hoboken: Wiley.

*Usability and Relationship to other Modules*

- The module is a mandatory / mandatory elective module of the Methods and Skills area that is part of the Jacobs Track (Methods and Skills modules; Community Impact Project module; Language modules; Big Questions modules).
- Mandatory for a major in IEM.
- Mandatory elective for a major in BCCB, EES and Physics.
- Elective for all other study programs.

*Examination Type: Module Examination*

Assessment type: Written examination — Duration 120 min, Weight: 100%

Scope: All intended learning outcomes of the module
Module achievements: 50% of the assignments passed

## 7.21.1.4 Applied Statistics with R

<table>
<tr><td colspan="2">Module Name<br><br>Applied Statistics with R</td><td>Module Code<br><br>JTMS-MET-03</td><td>Level (type)<br><br>Year 1 (Methods)</td><td>CP<br><br>5</td></tr>
<tr><td colspan="5">Module Components<br><br>Number | Name | Type | CP</td></tr>
<tr><td>JTMS-03</td><td colspan="2">Applied Statistics with R</td><td>Lecture & Lab</td><td>5</td></tr>
<tr><td>Module Coordinator<br><br>Adalbert Wilhelm</td><td colspan="2">Program Affiliation<br><br>• Jacobs Track – Methods and Skills</td><td colspan="2">Mandatory Status<br><br>Mandatory for GEM and IEM,<br><br>Mandatory elective for ISS, IBA, Psychology, IRPH</td></tr>
<tr><td colspan="2">Entry Requirements<br><br>Pre-requisites<br><br>☒ None<br><br>Co-requisites<br><br>☒ None<br><br>Knowledge, Abilities, or Skills<br><br>• none</td><td>Frequency<br><br>Annually<br><br>(Spring)<br><br>Duration<br><br>1 semester</td><td colspan="2">Forms of Learning and Teaching<br><br>• Lecture (17.5 hours)<br>• Lab (17.5 hours)<br>• Homework and self-study (90 hours)<br><br>Workload<br><br>125 hours</td></tr>
<tr><td colspan="5">Recommendations for Preparation<br>Get acquainted to statistical thinking by watching online videos for introductory probability and statistics as well as paying attention whenever arguments are backed up by empirical data.</td></tr>
<tr><td colspan="5">Content and Educational Aims<br><br>We live in a world full of data and more and more decisions are taken based on a comprehensive analysis of data. A central method of data analysis is the use of models describing the relationship between a set of predictor variables and a response. This module provides a thorough introduction to quantitative data analysis covering graphical representations, numerical summary statistics, correlation, and regression models. The module also introduces the fundamental concepts of statistical inference. Students learn about the different data types, how to best visualize them and how to draw conclusions from the graphical representations. Students will learn in this module the ideas and techniques of regression models within the generalized linear model framework involving multiple predictors and co-variates. Students will learn how to become an intelligent user of statistical techniques from a prosumers perspective to assess the quality of presented statistical results and to produce high-quality analyses by themselves. By using illustrative examples from economics, engineering, and the natural and social sciences students will gain the relevant background knowledge for their specific major as well as an interdisciplinary glimpse of other research fields. The general objective of the module is to enable students to become skilled statistical modelers who are well versed in the various assumptions, limitations, and controversies of statistical models and their application. Regular exercises and practical sessions will corroborate the students' proficiency with the statistical software R.</td></tr>
</table>

*Intended Learning Outcomes*

By the end of this module, students should be able to:

- apply basic techniques in statistical modeling and quantitative research methods
- describe fundamental statistical concepts, procedures, their assumptions and statistical fallacies
- explain the potential of using quantitative methods in all fields of applications;
- express informed skepticism of the limitations of statistical reasoning;
- interpret statistical modeling results in scientific publications;
- perform basic and intermediate-level statistical analyses of data, using R.

*Indicative Literature*

Michael J. Crawley (2013). The R Book, Second Edition. Hoboken: John Wiley & Sons.

Peter Daalgard (2008). Introductory Statistics with R. Berlin: Springer.

John Maindonald, W. John Braun (2010). Data Analysis and Graphics Using R – an Example-Based Approach, Third Edition, Cambridge Series. In *Statistical and Probabilistic Mathematics.* Cambridge: Cambridge University Press.

Christopher Gandrud (2015). Reproducible Research with R and RStudio, Second Edition. The R Series, Chapman & Hall/CRC Press.

Randall E. Schumacker (2014). Learning Statistics Using R. Thousand Oaks: Sage.

Charles Wheelan (2013). Naked Statistics: Stripping the Dread from The Data. New York: W.W. Norton & Company.

*Usability and Relationship to other Modules*

- The module is a mandatory / mandatory elective module of the Methods and Skills area that is part of the Jacobs Track (Methods and Skills modules; Community Impact Project module; Language modules; Big Questions modules).
- Quantitative analytical skills are used and needed in many modules of all study programs.
- Pre-requisite for Econometrics.
- This module introduces students to R in preparation for the 2nd year mandatory method module on econometrics and 3rd year GEM module on advanced econometrics; the statistics skills prepare students for all 2nd and 3rd year GEM modules and the thesis.
- Mandatory for a major in GEM and IEM.
- Mandatory elective for a major in IBA, IRPH, Psychology and ISS
- Elective for all other study programs.

*Examination Type: Module Examination*

Type: Written examination

Duration: 120 min
Weight: 100%

During the examination students use the software R as an auxiliary resource approved by the Instructor of Record.

Scope: All intended learning outcomes of the module.

### 7.21.2 Language Modules

The descriptions of the language modules are provided in a separate document, the "Language Module Handbook" that can be accessed from here: https://www.jacobs-university.de/study/learning-languages

# 8 Appendix

## 8.1 Intended Learning Outcomes Assessment-Matrix

| **Industrial Engineering & Management BSc** | | | | | General IE | General Logistics | Intro to Int. Business | Intro to Fin, Acc & Innovation | Process Model and Sim | Prod Planning & Control | Production & Technology Man | Product and Pr System Design | Operations Research | Lean Supply Man | Applied Project Management | Int. Strategic Management | Industry 4.0 and Blockchain Tech. | Advanced Product Design | Supply Chain Design | Integrated Decision Making in SCM | Distribution & E-commerce | Law of Transportation, For. and Log. | Elective CHOICE | Internship | Bachelor's Thesis | JT Methods | JT Language |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Semester | | | | | 1 | 2 | 1 | 2 | 3 | 4 | 4 | 3/4 | 3 | 3/4 | 3 | 4 | 6 | 6 | 6 | 6 | 6 | 6 | 1/2 | 5 | 6 | 1-4 | 1-4 |
| Mandatory (m) / Mandatory Elective (me) / optional (o) | | | | | m | m | m | m | m | m | m | m | m | m | m | m | me | me | me | me | me | me | o | m | m | m | m |
| Credits | | | | | 7.5 | 7.5 | 7.5 | 7.5 | 5 | 5 | 5 | 5 | 5 | 5 | 7.5 | 7.5 | 5 | 5 | 2.5 | 2.5 | 2.5 | 2.5 | 15 | 30 | 15 | 20 | 10 |
| | **Competencies*** | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Program Learning Outcomes** | **A** | **E** | **P** | **S** | | | | | | | | | | | | | | | | | | | | | | | |
| apply knowledge of engineering, management, logistics, and mathematics to identify, formulate, and solve problems in the field of industrial engineering | x | x | | | x | x | x | x | x | x | x | x | x | x | x | x | | | | | | | | x | x | x | |
| use current academic techniques, skills, and modern industrial engineering and management tools necessary for industrial practice (e.g. ABC/XYZ Analysis, Value Stream Mapping, Process Modeling and Simulation, Linear Programming, Demand Forecasting Methods, CAD drawings, Porter's 5 Forces, SWOT & PESTEL analyses, Business Model Canvas, etc.) | x | x | | | x | x | x | x | x | x | x | x | x | x | x | x | | | | | | | | x | | x | |
| create solutions to real industrial situations applying principles of industrial engineering, business administration, strategy, logistics and supply chain management (as seen in case studies and examples in class) | | x | | | x | x | x | x | x | | | | | x | x | x | x | x | x | x | x | x | | | | x | |
| design and conduct experiments, as well as to analyze and interpret data with the help of software (e.g. R) and programming languages (e.g. Python) | x | x | | | | | | | x | | | | x | | | | | | | | | | | | | x | |
| design a system or process to meet desired needs within realistic constraints such as economic, environmental, social, health and safety, manufacturability, and sustainability | | x | | | x | x | | | x | x | x | x | x | | | | x | x | x | x | x | | | x | | | |
| critically analyze industrial problems and make operational and strategic decisions involving complex or conflicting objectives | | x | | | x | x | | | | x | x | | x | | | | x | x | x | x | x | x | | | | | |
| discuss financial issues of a project and provide structured management reports about project progress | | x | | | | | x | x | | | | | | | x | x | | | | x | | | | | | | |
| take on responsibility in and lead a diverse and multidisciplinary team consisting of both technical and management professionals | | x | x | | | | | | | x | x | | | | x | x | x | x | x | x | x | | | | | | |
| professionally communicate their conclusions and recommendations in both spoken and written form, the underlying information and their reasons to specialists and non-specialists both clearly and unambiguously based on the state of research and | | x | x | | | | | | | | x | | | | x | x | x | x | x | x | x | | | x | x | | |
| discuss how the political, economic, social, and technological environments affect business functions in a globalized world | x | x | | x | | x | x | | | | | | | x | | x | | | | | | x | | | | | |
| use academic or scientific methods as appropriate in the field of industrial engineering and management such as defining research questions, justifying methods, collecting, assessing and interpreting relevant information, and drawing scientifically-founded conclusions that consider social, scientific and ethical insights | x | x | x | x | | | | | | | | | | | | | | | | | | | | | x | | |
| develop and advance solutions to problems and arguments in their subject area and defend these in discussions with specialists and non-specialists | x | x | | | | | | | | | | | | | | | x | x | x | x | x | | | x | x | | |
| engage ethically with academic, professional and wider communities and to actively contribute to a sustainable future, reflecting and respecting different views | x | x | x | x | | | | | | | | | | | | | | | | | | x | x | x | x | | |
| take responsibility for their own learning, personal and professional development and role in society, evaluating critical feedback and self-analysis | | | x | x | | | | | | | | | | x | x | | | | | | | | x | x | | | |
| apply their knowledge and understanding to a professional context | x | x | x | | | | x | x | | | | | | | x | x | | | | | | | | x | | | x |
| adhere to and defend ethical, scientific and professional standards | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x |
| **Assessment Type** | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| oral examination | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| written exam | | | | | x | x | x | x | | x | | x | x | x | | | | | | | | x | | | | x | |
| project | | | | | x | x | | | x | | x | x | | | | | x | x | x | x | x | | | x | | | |
| term paper | | | | | | | | | | | | | | x | | x | | | | | | | | x | | | |
| lab report | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| poster presentation | | | | | | | | | | | | | | | | | | | | | | | | x | x | | |
| presentation | | | | | | | | | | | | | | | x | | | | | | | | | | | | |
| various | | | | | | | | | | | | | | | | | | | | | | | x | | | | x |
| *Competencies: A-scientific/academic proficiency; E-competence for qualified employment; P-development of personality; S-competence for engagement in society | | | | | | | | | | | | | | | | | | | | | | | | | | | |

*Figure 4: Intended Learning Outcomes Assessment-Matrix*