CONSTRUCTOR UNIVERSITY

Study Program Handbook

Industrial Engineering and 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 4 of this handbook).

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1 Program Overview

1.1 Concept

1.1.1 The Constructor University Educational Concept

Constructor University aims to educate students for both an academic and a professional career by emphasizing three core objectives: academic excellence, personal development, and employability to succeed in the working world. Constructor University offers an excellent research driven education experience across disciplines 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. Through a multi-disciplinary, holistic approach and exposure to cutting-edge technologies and challenges, Constructor University develops and enables the academic excellence, intellectual competences, societal engagement, professional and scientific skills of tomorrows leaders for a sustainable and peaceful future.

In this context, it is Constructor 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 Constructor 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, optional German language and Humanities modules, 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, Constructor University offers professional advising and counseling.

Constructor 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 one of the most widely observed university rankings, the Times Higher Education (THE) ranking. More details on the current ranking positions can be found at https://constructor.university/more/about-us.

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 Constructor 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 Constructor 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 Constructor 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 Constructor University

Of the many reasons to enroll in the IEM program at Constructor 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 Student Career Support (SCS)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 Constructor University 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 in-presence 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 Constructor 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 (hybrid) career events, such as “IEM Internship Day”, the annual Career Fair, company visits and field days. Moreover, Constructor University’s international campus is the perfect environment for the in-presence 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 Constructor University 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 community on 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:

1. apply knowledge of engineering, management, logistics, and mathematics to identify, formulate, and solve problems in the field of industrial engineering;
2. 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.);
3. 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);
4. 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);
5. design a system or process to meet desired needs within realistic constraints, such as economic, environmental, social, health and safety, manufacturability, and sustainability constraints;
6. critically analyze industrial problems and make operational and strategic decisions involving complex or conflicting objectives;
7. discuss the financial issues of a project and provide structured management reports about project progress;
8. take on responsibility in and lead a diverse and multidisciplinary team consisting of both technical and management professionals;
9. 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;
10. discuss how the political, economic, social, and technological environments affect business functions in a globalized world;
11. 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;
12. develop and advance solutions to problems and arguments in their subject area and defend these in discussions with specialists and non-specialists;
13. engage ethically with academic, professional, and wider communities and actively contribute to a sustainable future, reflecting and respecting different views;

14. take responsibility for their own learning, personal and professional development and role in society, evaluating critical feedback and self-analysis;
15. apply their knowledge and understanding to a professional context;
16. adhere to and defend ethical, scientific, and professional standards.

1.4 Career Options and Support

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 any industrial companies looking for experts who can design, plan, control and manage industrial systems. Graduates are especially qualified for tasks in the fields of Logistics, Supply Chain Management, Procurement, Manufacturing and Automation, Process Optimization, Product Management, Project Management, Data Science and Information Technology (IT). 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/product management careers 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, Henkel, Barry Callebaut, Zalando, Röhlig, Porsche, Lufthansa Cargo, Hello Fresh, Forvia, Deloitte, EY 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 Service Center (CSC) helps students in their career development. It 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 aspects, thus helping students identify and follow up on rewarding careers after graduating from Constructor 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.

For further information, please contact the Career Service Center (CSC) (https://constructor.university/student-life/career-services).

1.5 Admission Requirements

Admission to Constructor University is selective and based on a candidate's school and/or university achievements, recommendations, self-presentation, and performance on standardized tests. Students admitted to Constructor 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 (optional)
- Official or certified copies of high school/university transcripts

- Educational History Form
- Standardized test results (SAT/ACT) if applicable
- Motivation statement
- ZeeMee electronic resume (optional)
- Language proficiency test results (TOEFL Score: 90, IELTS: Level 6.5 or equivalent)

Formal admission requirements are subject to higher education law and are outlined in the Admission and Enrollment Policy of Constructor University.

For more detailed information about the admission visit: https://constructor.university/admission-aid/application-information-undergraduate

1.6 More information and contacts

For more information on the study program please contact the Study Program Coordinator:

Dr. Stanislav Chankov

University Lecturer in Supply Chain Management

Email: schankov@constructor.university

or visit our program website: https://constructor.university/programs/undergraduate-education/industrial-engineering-management.

For more information on Student Services please visit:

https://constructor.university/student-life/student-services

2 The Curricular Structure

2.1 General

The curricular structure provides multiple elements for enhancing employability, interdisciplinarity, and internationality. The unique CONSTRUCTOR 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 Constructor 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 Constructor University can be found on the website (https://constructor.university/student-life/student-services/university-policies).

2.2 The Constructor University 4C Model

Constructor 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 undergraduate programs involve 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 4C Model. It groups the disciplinary content of the study program in three overarching themes, CHOICE-CORE-CAREER according to the year of study, while the university-wide CONSTRUCTOR Track is dedicated to multidisciplinary content dedicated to methods as well as intellectual skills and is integrated across all three years of study. The default module size is 5 CP, with smaller 2.5 CP modules being possible as justified exceptions, e.g., if the learning goals are more suitable for 2.5 CP and the overall student workload is balanced.

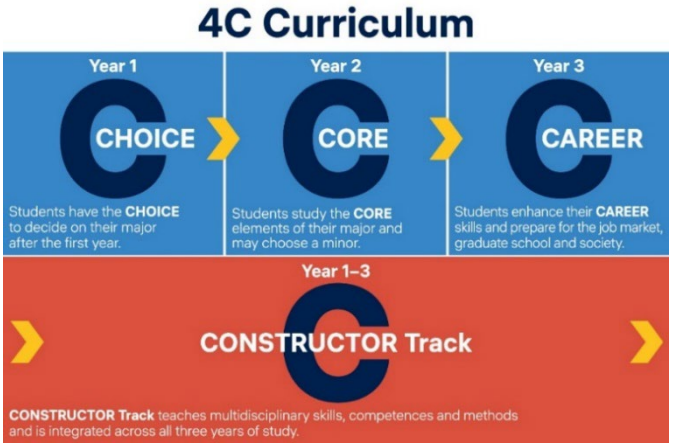

Figure 1: The Constructor University 4C-Model

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 15-45 CP will belong to their intended major. A unique feature of our curriculum structure allows students to select their major freely upon entering Constructor University. The team of Academic Advising Services offers curriculum counseling to all Bachelor students independently of their major, while Academic Advisors, in their capacity as contact persons from the faculty, support students individually in deciding on their major study program.

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

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

Students can still change to another major at the beginning of their second year of studies, provided they have taken the corresponding mandatory CHOICE modules in their first year of studies. All students must participate in an entry advising session with their Academic Advisors to learn about their major change options and consult their Academic Advisor prior to changing their major. (*Disclaimer: Major change options when entering the second year may differ for studies.)*

Students that would like to retain a further option are strongly recommended to additionally register for the CHOICE modules of one of the following study programs in their first year:

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

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

- Integrated Social and Cognitive Psychology (ISCP)
  CHOICE Module: Essentials of Cognitive Psychology (m, 7.5 CP)
  CHOICE Module: Essentials of Social Psychology (m, 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.
To pursue IEM as a major, at least the following mandatory CORE modules (30 CP) split in two units need to be taken:

1) "Advanced Industrial Engineering", consisting of the modules:
   CORE Module: Process Modelling & Simulation (m, 5 CP)
   CORE Module: Product & Production System Design (m, 5 CP)
   CORE Module: Production Planning & Control (m, 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 (m, 5 CP)
   CORE Module: Lean and Quality Management (m, 5 CP)
   CORE Module: AI and Data Management for Industrial Solutions (m, 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.

Students decide to complement their studies by taking the discipline-specific mandatory elective (me) CORE modules (15 CP) from the following unit:

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

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

or substitute these modules with CORE modules from other study programs according to interest and/or with the aim of pursuing a minor in a second field.

The "Project & Strategic Management" unit prepares students to set up, organize, manage and control projects as well as to evaluate and design strategies in international management.

IEM students can take CORE modules (or more advanced Specialization modules) from a second discipline, which allows them to incorporate a minor study track into their undergraduate education, within the 180 CP required for a bachelor's degree. The educational aims of a minor are to broaden students' knowledge and skills, support a critical reflection on statements in complex contexts, foster an interdisciplinary approach to problem-solving, and to develop an individual academic and professional profile in line with students' strengths and interests. This extra qualification will be highlighted in the transcript.

The Academic Advising Coordinator, Academic Advisor, and the Study Program Chair of the minor study program support students in the realization of the minor option. In addition, the consultation with the Academic Advisor is mandatory when choosing a minor.

As a rule, this requires IEM students to:

- select CHOICE modules (15 CP) from the desired minor program in the first year and

- substitute mandatory elective IEM CORE modules (15 CP) in the second year with the default minor CORE modules of the minor study program.

The requirements for each specific minor are described in the handbook of the study program offering the minor (Chapter 3.2) and are marked in Study and Examination Plans of the respective programs. For an overview of accessible minors, please check the Major/Minor Combination Matrix which is published at the beginning of each academic year.

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 sixth 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 Constructor 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 (15 CP) to focus on the development of their business plan. Students who take part in the startup option do a shortened full-time internship of minimum 8 weeks (15 CP) in the fifth semester.

For further information, please contact the Career Service Center (https://constructor.university/student-life/career-services).

During their mandatory internship semester, students of the IEM program are permitted to register to a limited number of modules/module components in accordance with the following regulations:

Students are permitted to take 10 CP of module registrations in addition to the internship module during their internship semester. On an exceptional basis, this may include modules that are otherwise restricted to students of online study programs. Retake audit registrations, renewed registrations to a module whose module achievement was not passed on a previous attempt, as well as modules whose classes take place during the intersession period in January, are exempted from this and do not count towards the 10 CP.

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 IEM as a major, at least 10 of the 15 CP from the following major-specific Specialization Modules need to be taken:

- IBA Specialization: Blockchain Technology and Applications (me, 5 CP)
- IEM Specialization: Advanced Product Design (me, 5 CP)
- IEM Specialization: Sustainable Supply Chain Management (me, 2.5 CP)
- IEM Specialization: Integrated Decision Making in Supply Chain Management (me, 2.5 CP)
- IEM Specialization: Distribution & E-Commerce (me, 2.5 CP)
- IEM Specialization: Law of Transportation, Forwarding and Logistics (me, 2.5 CP)
- IEM Specialization: Purchasing & Supply Management (me, 2.5 CP)

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

A maximum of 5 CP can be taken from the major-related course instead of major-specific Specialization Modules:

- RIS Specialization: Machine Learning (me, 5 CP)
- GEM Specialization: Econometrics (me, 5 CP)
- MDDA Specialization: Digital Marketing Fundamentals and SEO (me, 5 CP)

Students may also select 15 CP entirely from their major-specific Specialization Modules.

2.2.3.3 Study Abroad

The curriculum of IEM does not define a specific mobility window for study abroad. Students who desire to pursue this option have the option of individually arranging their study abroad stay by contacting the Study Program Chair.

For further information, please contact the International Programs office (https://constructor.university/student-life/study-abroad/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 Constructor University 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 Constructor University 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 CONSTRUCTOR Track

The CONSTRUCTOR Track is another important feature of Constructor University's educational model. The Constructor Track runs orthogonal to the disciplinary CHOICE, CORE, and CAREER modules across all study years and is an integral part of all undergraduate study programs. It provides an intellectual tool kit for lifelong learning and encourages the use of diverse methodologies to approach cross-disciplinary problems. The CONSTRUCTOR track contains Methods, New Skills and German Language and Humanities modules.

2.3.1 Methods 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 area. The size of all Methods modules is 5 CP.

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

- Methods Module: Applied Calculus (m, 5 CP)
- Methods Module: Finite Mathematics (m, 5 CP)
- Methods Module: Programming in Python (m, 5 CP)
- Methods Module: Applied Statistics with R (m, 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 New Skills Modules

This part of the curriculum constitutes an intellectual and conceptual tool kit that cultivates the capacity for a particular set of intellectual dispositions including curiosity, imagination, critical thought, and transferability. It nurtures a range of individual and societal capacities, such as self-reflection, argumentation and communication. Finally, it introduces students to the normative aspects of inquiry and research, including the norms governing sourcing, sharing, withholding materials and research results as well as others governing the responsibilities of expertise as well as the professional point of view.

All students are required to take the following modules in their second year:

- New Skills Module: Logic (m, 2.5 CP)
- New Skills Module: Causation and Correlation (m, 2.5 CP)

These modules will be offered with two different perspectives of which the students can choose. The module perspectives are independent modules which examine the topic from different point of views. Please see the module description for more details.

2.3.3 German Language and Humanities Modules

German language abilities foster students' intercultural awareness and enhance their employability in their host country. They are also beneficial for securing mandatory internships in German companies and academic institutions. Constructor University supports its students in acquiring basic as well as advanced German skills in the first year of the Constructor Track. Non-native speakers of German are encouraged to take 2 German modules (2.5 CP each), but are not obliged to do so. Native speakers and other students not taking advantage of this offering take alternative modules in Humanities in each of the first two semesters:

- Humanities Module: Introduction to Philosophical Ethics (me, 2.5 CP)
- Humanities Module: Introduction to the Philosophy of Science (me, 2.5 CP)
- Humanities Module: Introduction to Visual Culture Bremen in the World (me, 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 Constructor University 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

1. apply knowledge of engineering and logistics to identify, formulate, and solve problems in the field of industrial engineering;
2. 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);
3. create solutions to real industrial situations applying principles of logistics and supply chain management (as seen in case studies and examples in class);
4. 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 Logistics (m, 7.5 CP)

CHOICE Module: General Industrial Engineering (m, 7.5 CP)

CORE Module: Process Modeling and Simulation (m, 5 CP)

CORE Module: Product & Production System Design (m, 5 CP)

CORE Module: Production Planning & Control (m, 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 Constructor University in Fall 2026. In case of a conflict between the regulations in this handbook and the general Policies for Bachelor Studies, the latter apply (see https://constructor.university/student-life/student-services/university-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).

Updates to Study Program Handbooks are based on the policies approved by the Academic Senate on substantial and non-substantial changes to study programs. Students are integrated in the decision-making process through their respective committee representatives. All students affected by the changes will be properly informed.

In general, Constructor University therefore reserves the right to change or modify the regulations of the program handbook also after its publication at any time and in its sole discretion.

4.2 Examination Concept

According to the Policies for Bachelor and Master studies, modules generally carry at least five ECTS. Each program ensures appropriate examination frequency and organization, justified in an examination concept and regularly reviewed with student involvement.

Constructor University's examination concept follows the principle of Constructive Alignment (Biggs 1996), ensuring that learning outcomes, activities, and assessments are consistently aligned: students learn what is intended, and assessments both measure and shape learning. Where one assessment cannot cover all Intended Learning Outcomes (ILOs) complementary forms could be used (e.g., written exams plus lab reports). Module descriptions map ILOs to assessments.

In specific contexts, such as asynchronous online modules or courses emphasizing student engagement, Module Achievements or other types of formative assessments may support competence-oriented assessment.

Student feedback, embedded in the Quality Assurance System (QAS), systematically monitors workload, competence orientation, and alignment of ILOs and assessments. Student surveys and feedback are regulated in the Policy for student surveys and evaluations.

4.3 Degree

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

4.4 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.

4.5 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.

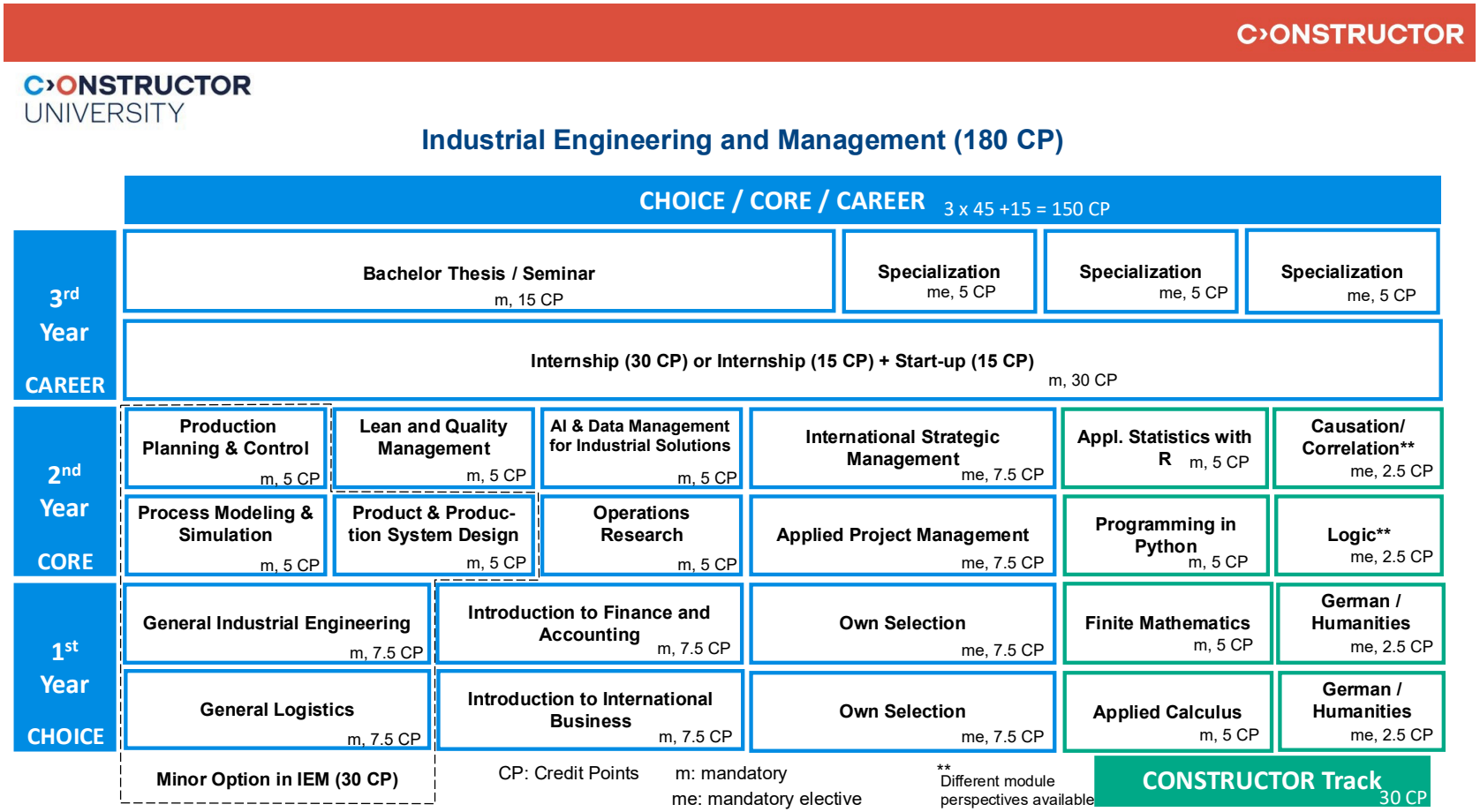

Figure 2: Schematic Study Plan for IEM

4.6 Study and Examination Plan

Industrial Engineering and Management (IEM) BSc

Matriculation Fall 2026

	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-241	**Module: General Logistics**				**m**	**1**	**7.5**
CH-241-A	Introduction to Logistics & Supply Chain Management	Lecture	Written examination	Examination period			5
CH-241-B	Logistics Lab	Lab	Project assessment	During the semester			2.5
CH-240	**Module: General Industrial Engineering**				**m**	**2**	**7.5**
CH-240-A	Industrial Engineering	Lecture	Written examination	Examination period			5
CH-240-B	Basics of Manufacturing Technology	Lab	Project Assessment	During the semester			2.5
CH-300	**Module: Introduction to International Business**				**m**	**1**	**7.5**
CH-300-A	Introduction to International Business	Lecture	Written examination	Examination period			5
CH-300-B	Introduction to International Business	Seminar					2.5
CH-301	**Module: Introduction to Finance and Accounting**				**m**	**2**	**7.5**
CH-301-A	Introduction to Finance	Seminar	Written examination	Examination period			2.5
CH-301-B	Introduction to Accounting	Seminar					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 in the first two units below. The modules in the unit Management can be substituted with default minor CORE modules of a minor study program.							
	Unit: Advanced Industrial Engineering (Default minor)						**15**
CO-582	**Module: Process Modelling & Simulation**				**m**	**3**	**5**
CO-582-A	Process Modelling & Simulation	Lab	Project assessment	During the semester			
CO-581	**Module: Product & Production System Design**				**m**	**3**	**5**
CO-581-A	Fundamentals of Engineering Design	Lab	Project Assessment	During the semester		3	2.5
CO-581-B	Advanced Production System Design	Lecture	Project Assessment	Examination period		3	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 & Quality Management**				**m**	**4**	**5**
CO-584-A	Lean & Quality Management	Lecture	Written examination	Examination period		4	5
CO-586	**Module: AI and Data Management for Industrial Solutions**				**m**	**4**	**5**
CO-586-A	AI and Data Management for Industrial Solutions	Lecture	Project assessment	During the semester			
	Unit: Management						**15**
CO-600	**Module: Applied Project Management**				**me**	**3**	**7.5**
CO-600-A	Applied Project Management	Lecture	Presentation	During the semester			5
CO-600-B	Applied Project Management	Seminar					2.5
CO-601	**Module: International Strategic Management**				**me**	**4**	**7.5**
CO-601-A	International Strategic Management	Lecture	Portfolio	During the semester			5
CO-601-B	International Strategic Management	Seminar					2.5

	CONSTRUCTOR Track Modules (General Education)	Type	Assessment	Period	Status[1]	Sem.	CP
	Unit: Methods						**10**
Take all mandatory methods modules listed below.							
CTMS-MAT-08	**Module: Applied Calculus**				**m**	**1**	**5**
CTMS-08	Applied Calculus	Lecture	Written examination	Examination period			
CTMS-MAT-11	**Module: Finite Mathematics**				**m**	**2**	**5**
CTMS-11	Finite Mathematics	Lecture	Written examination	Examination period			
	Unit: German Language and Humanities (choose one module for each sememter)				**m**		**5**
German is open to Non-German speakers (on campus and online).[4]							
CTLA-	**Module: Language 1**				**me**	**1**	**2.5**
CTLA-	Language 1	Seminar	Various	Various			
CTLA-	**Module: Language 2**				**me**	**2**	**2.5**
CTLA-	Language 2	Seminar	Various	Various			
CTHU-HUM-001	**Humanities Module: Introduction to Philosophical Ethics**				**me**	**1**	**2.5**
CTHU-001	Introduction to Philosophical Ethics	Lecture (online)	Written examination	Examination period			
CTHU-HUM-002	**Humanities Module: Introduction to the Philosophy of Science**				**me**	**2**	**2.5**
CTHU-002	Introduction to the Philosophy of Science	Lecture (online)	Written examination	Examination period			
CTHU-HUM-003	**Introduction to Visual Culture**				**me**	**2**	**2.5**
CTHU-003	Introduction to Visual Culture	Lecture (online)	Written examination	Examination period			
	Unit: Methods						**10**
CTMS-SKI-14	**Module: Programming in Python**				**m**	**3**	**5**
CTMS-14	Programming in Python	Lecture	Written examination	Examination period			
CTMS-MET-03	**Module: Applied Statistics with R**				**m**	**4**	**5**
CTMS-03	Applied Statistics with R	Lecture/Lab	Written examination	Examination period			
	Unit: New Skills						**5**
CTNS-NSK- 01	**Module: Logic (perspective I)***				**me**	**3/5**	**2.5**
CTNS-01	Logic (perspective I)	Lecture (online)	Written Examination	Examination period			
CTNS-NSK-02	**Module: Logic (perspective II)***				**me**	**3/5**	**2.5**
CTNS-02	Logic (perspective II)	Lecture (online)	Written Examination	Examination period			
CTNS-NSK-03	**Module: Causation and Correlation (perspective I)***				**me**	**4/6**	**2.5**
CTNS-03	Causation and Correlation (perspective I)	Lecture (online)	Written Examination	Examination period			
CTNS-NSK-04	**Module: Causation and Correlation (perspective II)***				**me**	**4/6**	**2.5**
CTNS-04	Causation and Correlation (perspective II)	Lecture (online)	Written Examination	Examination period			
*These modules are offered with two different perspectives, students may only select one							

Year 3 - CAREER								60
Module Code	**Module: Guided Industrial Project / Mandatory Internship**				**m**	**5**	**30**	
CA-INT-901	Guided Industrial Project / Mandatory Internship	Internship	Project Report and	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	Thesis Seminar IEM	Seminar	Presentation	During the semester			3	
	Unit: Specialization IEM [3]				**m**	**6**	**15**	
Take a total of 15 CP of specialization modules								
CA-S-IEM-802	Advanced Product Design	Lab	Project Assessment	During the semester	me		5	
CA-S-IEM-804	Integrated Decision Making in Supply Chain Management	Seminar	Project Assessment	During the semester	me		2.5	
CA-S-IEM-805	Distribution & E-Commerce	Lecture	Project Assessment	During the semester	me		2.5	
CA-S-IEM-806	Law of Transportation, Forwarding and Logistics	Lecture	Written examination	Examination period	me		2.5	
CA-S-IEM-809	Sustainable Supply Chain Management	Seminar	Project Assessment	During the semester	me		2.5	
CA-S-IEM-810	Purchasing and Supply Management	Seminar	Project Assessment	During the semester	me		2.5	
CA-S-IBA-805	Blockchain Technology and Applications	Seminar	Term Paper	During the semester	me		5	
Total CP								**180**

[1] Status (m = mandatory, me = mandatory elective)

[2] For a full listing of all CHOICE / CORE / CAREER / Constructor Track modules please consult the CampusNet online catalogue and/or the study program handbooks

[3] Note that 15 CP specialization modules need to be taken, of which a minimum of 10 CP must be major-specific and max. 5 CP can be major-related

[4] German native speakers have alternatives to the language courses (in the field of Humanities).

Figure 3: Study and Examination Plan for IEM

5 Module Descriptions

5.1.1 General Logistics

Module Name	General Logistics
Module Code	CH-241
Module ECTS	7.5
Program Owner	IEM-BSc (Industrial Engineering & Management)
Module Coordinator	Dr. Stanislav Chankov

Study Semester		
Program	**Semester**	**Status**
IEM-BSc Industrial Engineering & Management	1	Mandatory
Minor-IEM Minor Option in IEM	1	Mandatory

Student Workload	
Lecture	35
Laboratory	22.5
Project Work	30
Independent Study	100
Total Hours	**187.5**

Module Components	**Number**	**Type**	**CP**
Introduction to Logistics & Supply Chain Management	CH-241-A	Lecture	5
Logistics Lab	CH-241-B	Laboratory	2.5

Module Description

The module consists of two module components, one lecture and one practical lab.

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.

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, production planning, and linear programming). In addition, students will also gain practical knowledge by means of different business games. 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. A case study based on The Fresh Connection game will prepare students to develop supply chain risk management strategies.

A single assessment type cannot sufficiently test all intended learning outcomes. The project assessment evaluates soft skills (teamwork, presentation) and practical skills in spreadsheet software, whereas the written examination assesses understanding of core concepts, principles, and analytical reasoning for logistics.

Recommended Knowledge

- Basic spreadsheet software skills (e.g. MS Excel)

- Learn or practice basic functions in a spreadsheet software (e.g. MS Excel).

Intended Learning Outcomes

No	Competence	ILO
1	Describe	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.
2	Explain	Explain the definitions and terms commonly used in the logistics and supply chain management realm.
3	Explain	Explain the linkages and differences between logistics and supply chain management.
4	Discuss	Discuss conflicting logistics and supply chain targets and their trade-offs from a holistic perspective.
5	Describe	Describe the processes, strategies, and tools of procurement, production and distribution logistics.
6	Model	Model business processes with the event-driven process chain notation.
7	Solve	Solve linear programming and transportation problems.
8	Explain	Explain the reasons behind one of the main problems in supply chain management: the Bullwhip effect.
9	Apply	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).
10	Derive	Derive recommendations for mitigating short-, medium- and long-term supply chain risks.
11	Collaborate	Collaborate effectively in teams to develop and deliver a presentation on a topic in the context of logistics and SCM.

Indicative Literature

- Andersen, M., & Skjoett-Larsen, T. (2009). Corporate social responsibility in global supply chains. Supply Chain Management: An International Journal,14(2), 75-86.
- Benton, W. C. (2013). Purchasing and Supply Chain Management: Third Edition. McGraw-Hill Higher Education.
- 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.
- DHL Trend Research (2019). Logistics Trend Radar, DHL Customer Solutions & Innovation, Troisdorf, Germany.
- Nix, N. W. (2001). Purchasing in a supply chain context. Supply Chain Management, 205-235.
- 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.
- Nyhuis, P., & Wiendahl, H. P. (2008). Fundamentals of production logistics: theory, tools and applications. Springer Science & Business Media.
- Rushton, A. et al. (2000). The Handbook of Logistics and Distribution Management. Kogan Page.

Entry Requirements

Prerequisites	None
Co-requisites	None
Additional Remarks	None

Assessment and Completion

Module Component	Examination Type	Duration or Length	Weight (%)	Minimum for Pass	ILOs
Introduction to Logistics & Supply Chain Management	Written Examination	180 minutes	67	45%	1-10
Logistics Lab	Project Assessment	group assessment	33	45%	9-11

Module Completion Requirements

- **Module Component Examination:** minimum pass 45% of each assessment.

Module Achievement

None.

5.1.2 General Industrial Engineering

Module Name	General Industrial Engineering
Module Code	CH-240
Module ECTS	7.5
Program Owner	IEM-BSc (Industrial Engineering & Management)
Module Coordinator	Dr. Georgi Dragolov Prof. Dr. Omid Fatahi Valilai

Study Semester		
Program	**Semester**	**Status**
IEM-BSc Industrial Engineering & Management	2	Mandatory
Minor-IEM Minor Option in IEM	2	Mandatory

Student Workload	
Lecture	35
Laboratory	17.5
Independent Study	90
Group Discussion	45
Total Hours	**187.5**

Module Components	**Number**	**Type**	**CP**
Industrial Engineering	CH-240-A	Lecture	5
Basics of Manufacturing Technology	CH-240-B	Laboratory	2.5

Module Description

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 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.

A single assessment type cannot sufficiently test all intended learning outcomes. The project report evaluates practical skills on Engineering Drawing, BOM, OPC creation and Time and motion study execution, whereas the written examination assesses understanding of core concepts, principles, and analytical reasoning for Industrial Engineering.

Recommended Knowledge

- 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.

Intended Learning Outcomes

No	Competence	ILO
1	Comprehend	Comprehend the main responsibilities of industrial engineering.
2	Understand	Understand and manage the whole process from product design to manufacturing.
3	Choose	Choose basic materials (e.g., steel) for different types of products.
4	Prepare	Prepare simple engineering drawings.
5	Calculate	Calculate the required number of machines for a given scope of manufacturing requirements.
6	Understand	Understand the importance of ergonomics and ergonomic workplace design.
7	Apply	Apply several scheduling techniques for production planning and control.
8	Reflect	Reflect on the applicability of current developments and trends in industrial engineering.

9	Describe	Describe the main manufacturing processes such casting, milling, welding, grinding, and the state-of-the-art tools and technologies used in these processes.
10	Apply	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.

Entry Requirements

Prerequisites	None
Co-requisites	None
Additional Remarks	None

Assessment and Completion

Module Component	Examination Type	Duration or Length	Weight (%)	Minimum for Pass	ILOs
Industrial Engineering	Written Examination	180 minutes	67	45%	1-9
Basics of Manufacturing Technology	Project Assessment	group assessment	33	45%	9-10

Module Completion Requirements

- **Module Component Examination:** minimum pass 45% of each assessment.

Module Achievement

None.

5.1.3 Introduction to International Business

Module Name	Introduction to International Business
Module Code	CH-300
Module ECTS	7.5
Program Owner	IBA-BA (International Business Administration)
Module Coordinator	Prof. Dr. Christoph Lattemann

Study Semester		
Program	**Semester**	**Status**
GEM-BA Global Economics and Management	1	Mandatory
IBA-BA International Business Administration	1	Mandatory
IEM-BSc Industrial Engineering & Management	1	Mandatory
MDDA-BSc Management, Decisions and Data Analytics	1	Mandatory
Minor-EIM-BSc Minor EIM	1	Mandatory

Student Workload	
Seminar	17.5
Independent Study	50
Independent Study	85
Lecture	35
Total Hours	**187.5**

Module Components	**Number**	**Type**	**CP**
Introduction to International Business	CH-300-A	Lecture	5
Introduction to International Business - Seminar	CH-300-B	Seminar	2.5

Module Description

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.

Intended Learning Outcomes

No	Competence	ILO
1	Understand	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.
2	Describe	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.
3	Describe	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.
4	Describe	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.
5	Discuss	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.
6	Describe	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.
7	Define	Define regional economic integration and identify its five levels. Discuss the benefits and drawbacks associated with regional economic integration.
8	Discuss	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.
9	Explain	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.
10	Identify	Identify international strategies and the corporate-level strategies that companies use.
11	Discuss	Discuss the important issues that influence the choice of organizational structure.

12	Explain	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.
13	Explain	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).
14	Use	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.

Entry Requirements

Prerequisites	None
Co-requisites	None
Additional Remarks	None

Assessment and Completion

Module Component	Examination Type	Duration or Length	Weight (%)	Minimum for Pass	ILOs
Introduction to International Business	Written Examination	120 Minutes	100	45%	1-14
Introduction to International Business - Seminar					

Module Completion Requirements

- **Module Examination:** minimum for pass- 45%.

Module Achievement

To pass the module achievement, the average of five case studies (+ one case presentation) has to be 45% or higher. Apart from acquiring practical skills, each participant further needs to demonstrate sufficient understanding of the application of business frameworks for a given context and business challenge. Only with sufficient knowledge, students show that they understand business problems and can solve the challenges by using business frameworks. This is a basic requirement to show that students are ready for the final exam. If the average of all quizzes is lower than 45 %,students have to re-take the course again.

5.1.4 Introduction to Finance and Accounting

Module Name	Introduction to Finance and Accounting
Module Code	CH-301
Module ECTS	7.5
Program Owner	IBA-BA (International Business Administration)
Module Coordinator	Prof. Dr. Andreas Seebeck

Study Semester		
Program	**Semester**	**Status**
GEM-BA Global Economics and Management	2	Mandatory
IBA-BA International Business Administration	2	Mandatory
IEM-BSc Industrial Engineering & Management	2	Mandatory
MDDA-BSc Management, Decisions and Data Analytics	2	Mandatory
Minor-EIM-BSc Minor EIM	2	Mandatory

Student Workload	
Lecture	35
Tutorial	17.5
Independent Study	135
Total Hours	**187.5**

Module Components	**Number**	**Type**	**CP**
Introduction to Finance	CH-301-A	Lecture	2.5
Introduction to Accounting	CH-301-B	Lecture	2.5
Finance and Accounting Tutorial	CH-301-C	Tutorial	2.5

Module Description

This module introduces students to the basics of finance and financial accounting. 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 offers an overview of the different sources of finance from private and public sources, and it introduces several important analytical tools and techniques from corporate finance.

The second part focuses on financial accounting. It outlines the framework of accounting including its nature, purposes, and the context. In addition, it covers the basic concepts, conventions, and principles

of accounting as well as the accounting equation. Moreover, the recognition and measurement principles are taught. Finally, the module covers the preparation and analysis of financial statements. This part uses the International Financial Reporting Standards as reference.

The third part of the module is designed as a tutorial. In this tutorial students repeat, apply, and practice the techniques from both finance and accounting lectures. Students work on exercises individually and in small groups.

Usability and Relationship to other Modules

- Builds on the module “Introduction to International Business”

- The module prepares students for the CORE modules in the second and third study year

Recommended Knowledge

It is recommended that students have passed "Introduction to International Business" before attending "Introduction to Finance and Accounting.

Intended Learning Outcomes

No	Competence	ILO
1	Define	Define the basic types of financial management decisions and the role of the financial manager.
2	Explain	Explain the goal of financial management.
3	Compute	Compute the external financing needed to fund a firm’s growth and name the determinants of a firm’s growth.
4	Determine	Determine the future value of an investment made today and the present value of cash to be received at a future date.
5	Define	Define important bond features, types of bonds, and bond ratings.
6	Outline	Outline the impact of inflation on interest rates.
7	Apply	Apply the Present Value (PV), Net Present Value (NPV), Payback rule, Internal Rate of Return (IRR), and the Profitability Index (PI).
8	Apply	Apply the concept of scenario and sensitivity analysis, calculate the tax shield, accounting break-even point and degree of operating leverage.
9	Identify	Identify and describe the major functions of financial accounting and financial reporting.
10	Explain	Explain the relationship between financial statement elements.
11	Describe	Describe the roles and desirable attributes of financial reporting standards.
12	Demonstrate	Demonstrate knowledge and understanding of the elements of the balance sheet, income statement, cash flow statement, and statement of shareholders’ equity.
13	Describe	Describe, explain, and classify cash flow items.

Indicative Literature

- Phillips, F., Clor-Proell, S., Libby,R., Libby P. (2021). Fundamentals of Financial Accounting, 7th Edition. New York: McGraw-Hill Education.
- Ross, S.A., Westerfield, R. and Jordan, B.D., 2023. Fundamentals of corporate finance, 13th Edition. Tata McGraw-Hill Education.

Entry Requirements

Prerequisites	None
Co-requisites	None
Additional Remarks	None

Assessment and Completion

Module Component	Examination Type	Duration or Length	Weight (%)	Minimum for Pass	ILOs
Introduction to Finance	Written Examination	120 Minutes	100	45%	1-13
Introduction to Accounting					
Finance and Accounting Tutorial					

Module Completion Requirements

- **Module Examination:** minimum for pass- 45%.

Module Achievement

None.

5.1.5 Process Modeling and Simulation

Module Name	Process Modeling and Simulation
Module Code	CO-582
Module ECTS	5
Program Owner	IEM-BSc (Industrial Engineering & Management)
Module Coordinator	Dr. Georgi Dragolov

Study Semester		
Program	**Semester**	**Status**
IEM-BSc Industrial Engineering & Management	3	Mandatory
Minor-IEM Minor Option in IEM	3	Mandatory

Student Workload	
Lecture	17.5
Laboratory	17.5
Group Discussion	45
Independent Study	45
Total Hours	**125**

Module Components	**Number**	**Type**	**CP**
Process Modeling and Simulation	CO-582-A	Laboratory	5

Module Description

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.

Recommended Knowledge

Chung, C.A. (2004): Simulation Modeling Handbook – A Practical Approach. CRC Press. Boca Raton, FL.

Usability and Relationship to other Modules

The module builds on the 1st -year IEM CHOICE modules General Industrial Engineering and General Logistics.

Intended Learning Outcomes

No	Competence	ILO
1	Distinguish	Distinguish between the three simulation and modeling methods.
2	Create	Create discrete-event simulation models to analyze logistical parameters.
3	Create	Create agent-based models to understand the impact of individual behavior on the overall system.
4	Create	Create system dynamics models to understand the dynamics of a highly aggregate system.
5	Analyze	Analyze bottlenecks and find improvement potential.

Indicative Literature

- Chung, C.A. (2004). Simulation Modeling Handbook – A Practical Approach. CRC Press. Boca Raton, FL.

Entry Requirements

Prerequisites	CH-240 General Industrial Engineering CH-241 General Logistics
Co-requisites	None
Additional Remarks	None

Assessment and Completion

Module Component	Examination Type	Duration or Length	Weight (%)	Minimum for Pass	ILOs
Process Modeling and Simulation	Project Assessment		100	45%	1-5

Module Completion Requirements

- **Module Examination:** minimum for pass- 45%.

Module Achievement

None.

5.1.6 Production Planning & Control

Module Name	Production Planning & Control
Module Code	CO-580
Module ECTS	5
Program Owner	IEM-BSc (Industrial Engineering & Management)
Module Coordinator	Prof. Dr.-Ing. Hendro Wicaksono

Study Semester		
Program	**Semester**	**Status**
IEM-BSc Industrial Engineering & Management	4	Mandatory
Minor-IEM Minor Option in IEM	4	Mandatory

Student Workload	
Lecture	35
Independent Study	90
Total Hours	**125**

Module Components	**Number**	**Type**	**CP**
Production Planning and Control	CO-580	Lecture	5

Module Description

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.

Recommended Knowledge

- Basic spreadsheet software skills (e.g. MS Excel)

- Hopp, W. J. & Spearman, M. L., Factory Physics: Foundations of Manufacturing Management, 3rd edition, Waveland Press Inc., 2011.

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

Usability and Relationship to other Modules

- 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.

Intended Learning Outcomes

No	Competence	ILO
1	Explain	Explain the objectives of production systems, their trade-offs, and the role of production planning and control (PPC).
2	Apply	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.
3	Apply	Apply mathematical and statistical methods, such as linear programming, linear regression, decision tree, etc., to solve production planning and control problems.
4	Develop	Develop concepts to apply new technologies to improve PPC activities.
5	Demonstrate	Demonstrate the impacts of new production requirements on PPC activities, such as green production and lot size one production.
6	Give	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.

Entry Requirements

Prerequisites	CH-241 General Logistics
Co-requisites	None
Additional Remarks	None

Assessment and Completion

Module Component	Examination Type	Duration or Length	Weight (%)	Minimum for Pass	ILOs
Production Planning and Control	Written Examination	120 Minutes	100	45%	1-6

Module Completion Requirements

- **Module Examination:** minimum for pass- 45%.

Module Achievement

None.

5.1.7 Product & Production System Design

Module Name	Product & Production System Design
Module Code	CO-581
Module ECTS	5
Program Owner	IEM-BSc (Industrial Engineering & Management)
Module Coordinator	Prof. Dr. Omid Fatahi Valilai

Study Semester		
Program	**Semester**	**Status**
IEM-BSc Industrial Engineering & Management	3	Mandatory
Minor-IEM Minor Option in IEM	3	Mandatory

Student Workload	
Lecture	17.5
Laboratory	17.5
Group Discussion	45
Independent Study	45
Total Hours	**125**

Module Components	**Number**	**Type**	**CP**
Fundamentals of Engineering Design	CO-581-A	Laboratory	2.5
Advanced Production System Design	CO-581-B	Lecture	2.5

Module Description

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.

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.

A single assessment type cannot sufficiently test all intended learning outcomes. The 1st project report evaluates practical skills on using CAD/CAPP solutions for Fundamental of Engineering Design course, whereas the 2nd project assessment targets understanding of core concepts, principles, and analytical reasoning for integration of CAD/CAM/CNC and 3D printing Technologies.

Recommended Knowledge

- Basic spreadsheet software skills (e.g. MS Excel)

- Revise the material from the General Industrial Engineering module on technical drawings and production system design.

Usability and Relationship to other Modules

The module builds on the 1st-year IEM CHOICE module General Industrial Engineering.

Intended Learning Outcomes

No	Competence	ILO
1	Become	Become familiar with the design process and learn creative approaches to problem solving.
2	Produce	Produce 3D modelling parts, assemblies, and technical drawings using a 3D modeling software.
3	Become	Become proficient in record keeping through the use of an Engineering Journal.
4	Apply	Apply CAx systems to design simple product prototypes.
5	Analyze	Analyze product portfolios as to their cost structures and profit contribution using clustering techniques (e.g., ABC, XYZ).
6	Calculate	Calculate the required number of machines for a given scope of manufacturing requirements.
7	Define	Cluster and define machine groups using clustering techniques.
8	Design	Design a proper layout for the selected machines.
9	Design	Design a manual workstation using the MTM method.

Indicative Literature

- Altintas, Y. (2012). Manufacturing automation metal cutting mechanics, machine tool vibrations, and CNC design, Cambridge University Press.
- Architecture Technology Corp (1991). Computer Aided Process Planning (CAPP), Elsevier Advanced Technology.
- Groover, M. (1996). Fundamentals of modern manufacturing, Wiley.
- Hopp, W.J. & Spearman, M.L. (2011).Factory Physics. 3rd Edition, Waveland Publishing.

Entry Requirements

Prerequisites	CH-240 General Industrial Engineering

Co-requisites	None
Additional Remarks	None

Assessment and Completion

Module Component	Examination Type	Duration or Length	Weight (%)	Minimum for Pass	ILOs
Fundamentals of Engineering Design	Project Assessment		50	45%	1-4
Advanced Production System Design	Project Assessment		50	45%	5-9

Module Completion Requirements

- **Module Component Examination:** minimum pass 45% of each assessment.

Module Achievement

None.

5.1.8 Operations Research

Module Name	Operations Research
Module Code	CO-583
Module ECTS	5
Program Owner	IEM-BSc (Industrial Engineering & Management)
Module Coordinator	Dr. Mahdi Homayouni

Study Semester		
Program	**Semester**	**Status**
IEM-BSc Industrial Engineering & Management	3	Mandatory
RIS-BSc Robotics and Intelligent Systems	5	Mandatory Elective

Student Workload	
Independent Study	90
Lecture	35
Total Hours	**125**

Module Components	**Number**	**Type**	**CP**
Operations Research	CO-583-A	Lecture	5

Module Description

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.

Recommended Knowledge

- Revise basic calculus, matrix algebra and spreadsheet software functions.

- Basic spreadsheet software skills (e.g. MS Excel)

- Basic calculus and matrix algebra

- Basic knowledge in logistics

Usability and Relationship to other Modules

Serves as a 3rd-year Specialization module for major students in RIS

Intended Learning Outcomes

No	Competence	ILO
1	Calculate	Calculate optimal or near-optimal solutions to complex decision-making problems using operations research methods.
2	Design	Design mathematical models for business problems.
3	Apply	Apply techniques such as linear programming, dynamic programming or stochastic programming to solve business problems.
4	Resolve	Resolve common network optimization problems such as transportation, shortest path, minimum spanning tree, and maximum flow problems.

Indicative Literature

- Hillier, F. S. & Lieberman, G.J. (2009). Introduction to Operations Research. McGraw-Hill. New York, NY.

Entry Requirements

Prerequisites	None
Co-requisites	None
Additional Remarks	None

Assessment and Completion

Module Component	Examination Type	Duration or Length	Weight (%)	Minimum for Pass	ILOs
Operations Research	Written Examination	120 Minutes	100	45%	1-4

Module Completion Requirements

- **Module Examination:** minimum for pass- 45%.

Module Achievement

None.

5.1.9 Lean and Quality Management

Module Name	Lean and Quality Management
Module Code	CO-584
Module ECTS	5
Program Owner	IEM-BSc (Industrial Engineering & Management)
Module Coordinator	Dr. Mahdi Homayouni

Study Semester		
Program	**Semester**	**Status**
IEM-BSc Industrial Engineering & Management	4	Mandatory

Student Workload	
Lecture	35
Independent Study	90
Total Hours	**125**

Module Components	**Number**	**Type**	**CP**
Lean and Quality Management	CO-584-A	Lecture	5

Module Description

The module explores the principles of quality management and lean management, focusing on their combined role in enhancing operational efficiency, reducing waste, and quality assurance. It particularly addresses modern industrial challenges through data-driven and value-oriented approaches.

Key topics include quality management, quality assurance, and the analytical skills necessary for making data-driven decisions in quality control and improvement. Students will learn about Statistical Process Control (SPC), process capability analysis, and acceptance sampling, and how these tools can be used to monitor, evaluate, and improve manufacturing and service processes.

The module also emphasizes the implementation and enhancement of 20th-century lean methods in modern manufacturing, centered around the kaizen philosophy, which promotes continuous improvement. Topics such as the elimination of waste (Muda), value stream mapping, change management processes, Six Sigma, zero defects, and mistake-proofing (Poka Yoke) will be covered. Additionally, students will study lean manufacturing principles, including pull production, single-piece flow, and the single-minute exchange of dies.

The module consists of a theoretical overview of these techniques, allowing students to apply their knowledge practically through game-based activities and industry-relevant case studies. Emphasis is placed on the importance of real-time data collection, predictive analytics, and automation in achieving zero defects and continuous improvement. Specifically, students will apply the value stream mapping method to a real-world case study.

Usability and Relationship to other Modules

Elective for all other undergraduate study programs.

Recommended Knowledge

Revise material from the 1st year related to lean and quality management.

Intended Learning Outcomes

No	Competence	ILO
1	Describe	Describe key concepts of quality management and lean management.
2	Implement	Implement statistical tools such as Statistical Process Control (SPC) and process capability analysis.
3	Analyze	Analyze industrial data sets to monitor process performance and identify improvement opportunities.
4	Use	Use acceptance sampling techniques to assess product quality and make data-driven.
5	Identify	Identify different waste types in industrial processes and suggest ways to reduce or eliminate them.
6	Evaluate	Evaluate as-is processes and propose improvements based on lean principles and the kaizen philosophy.
7	Apply	Apply value stream mapping to analyze and optimize industrial processes.

Indicative Literature

- Montgomery, D. C. (2020). Introduction to statistical quality control. 8th Edition, John wiley & sons.
- 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.

Entry Requirements

Prerequisites	CH-300 Introduction to International Business CH-241 General Logistics CH-240

	General Industrial Engineering
Co-requisites	None
Additional Remarks	None

Assessment and Completion

Module Component	Examination Type	Duration or Length	Weight (%)	Minimum for Pass	ILOs
Lean and Quality Management	Written Examination	120 Minutes	100	45%	1-7

Module Completion Requirements

- **Module Examination:** minimum for pass- 45%.

Module Achievement

None.

5.1.10 AI and Data Management for Industrial Solutions

Module Name	AI and Data Management for Industrial Solutions
Module Code	CO-586
Module ECTS	5
Program Owner	IEM-BSc (Industrial Engineering & Management)
Module Coordinator	Prof. Dr.-Ing. Hendro Wicaksono

Study Semester		
Program	**Semester**	**Status**
IEM-BSc Industrial Engineering & Management	4	Mandatory

Student Workload	
Lecture	27.5
Seminar	7.5
Independent Study	30
Group Discussion	60
Total Hours	**125**

Module Components	**Number**	**Type**	**CP**
AI and Data Management for Industrial Solutions	CO-586-A	Lecture	5

Module Description

The exponential growth of data in industrial systems, driven by the spread of the Internet of Things (IoT) and digital transformation across sectors such as production and logistics, has made big data and Artificial Intelligence (AI) crucial topics. Big data is characterized by its vast size, high generation and transfer velocity, diverse formats, and complex validation requirements. Traditional data management and analysis approaches are insufficient to handle these challenges.

To extract actionable insights and create value from data, advanced data management and analytics techniques powered by artificial intelligence (AI) are essential. AI, especially machine learning, offers powerful capabilities for analyzing complex datasets, enabling predictive modeling, anomaly detection, and automated decision-making processes to optimize industrial operations.

This module emphasizes practical applications of data management and AI and machine learning in data analytics, covering the following topics:

- Techniques for modeling data using graphical notations to understand relationships and dependencies.

- SQL for data storage, querying, and processing.

- Application of supervised and unsupervised learning techniques, including time series analysis, regression models, classification algorithms, and clustering methods to uncover hidden patterns, correlations, and trends in data.

- Real-world applications of AI-driven analytics in industrial systems, for example on energy consumption prediction and optimization, supply chain analytics, and process automation.

- Development of innovation and business models for data-driven services and AI solutions

Recommended Knowledge

- Basic IT and programming understanding

- Basic Python/R programming

- Basic functions in a spreadsheet software (e.g., MS Excel)

Intended Learning Outcomes

No	Competence	ILO
1	Identify	Identify scenarios in industrial systems and evaluate the opportunities and challenges of AI and data management applications.
2	Apply	Apply data modelling approaches using graphical notations and data management approaches using SQL tools.
3	Determine	Determine the objective of data analytics and machine learning in different industrial scenarios and the data sources required to achieve the objectives.
4	Apply	Apply machine learning and statistical analytics methods and tools to uncover hidden patterns, correlations, trends, and knowledge that are useful to improve industrial processes.
5	Evaluate	Evaluate data analytics results in different industrial scenarios and solve the problems that might occur during the whole data analytics processes from data collection to AI applications.
6	Develop	Develop innovation and business models as well as the related ecosystem concepts for data-driven services and AI solutions.

Indicative Literature

- Bruce, Peter; Bruce, Andrew (2017). Practical Statistics for Data Scientists, O'Reilly Media, ISBN: 9781491952962.
- Géron, A. (2022). Hands-on machine learning with Scikit-Learn, Keras, and TensorFlow. " O'Reilly Media, Inc.".
- Müller, A. C., & Guido, S. (2016). Introduction to machine learning with Python: a guide for data scientists. " O'Reilly Media, Inc.".
- Murphy, K. P. (2022). Probabilistic machine learning: an introduction. MIT press.
- Osterwalder, Alexander; Pigneur, Yves (2010). Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers. John Wiley and Sons, ISBN: 978-0470876411.

- Vasilik, Sylvia Moestl (2017). SQL Practice Problems: 57 beginning, intermediate, and advanced challenges, ISBN: 978-1520807638.

Entry Requirements

Prerequisites	CH-240 General Industrial Engineering CH-241 General Logistics
Co-requisites	None
Additional Remarks	None

Assessment and Completion

Module Component	Examination Type	Duration or Length	Weight (%)	Minimum for Pass	ILOs
AI and Data Management for Industrial Solutions	Project Assessment		100	45%	1-6

Module Completion Requirements

- **Module Examination:** minimum for pass- 45%.

Module Achievement

None.

5.1.11 Applied Project Management

Module Name	Applied Project Management
Module Code	CO-600
Module ECTS	7.5
Program Owner	IBA-BA (International Business Administration)
Module Coordinator	Prof. Dr. Lennart Ante

Study Semester		
Program	**Semester**	**Status**
IBA-BA International Business Administration	3	Mandatory Elective
IEM-BSc Industrial Engineering & Management	3	Mandatory Elective
Minor-EIM-BSc Minor EIM	3	Mandatory
IRPH-BA International Relations: Politics and History	5	Mandatory Elective

Student Workload	
Lecture	35
Seminar	17.5
Independent Study	135
Total Hours	**187.5**

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

Module Description

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.

Recommended Knowledge

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

Intended Learning Outcomes

No	Competence	ILO
1	Identify	Identify and memorize the key skills to manage projects, including internationally accepted standards and procedures for running and controlling projects.
2	Apply	Apply project management skills to set up, organize, manage and control (real) projects.
3	Analyze	Analyze project performance.
4	Develop	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.
- Larson, E.W.; Gray, C. (2017). Project management: the managerial process, 7th edition. New York: McGraw-Hill Education.
- 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.
- 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.

Entry Requirements

Prerequisites	CH-300 Introduction to International Business CH-301 Introduction to Finance and Accounting
Co-requisites	None

Additional Remarks	None

Assessment and Completion

Module Component	Examination Type	Duration or Length	Weight (%)	Minimum for Pass	ILOs
Applied Project Management	Presentation	45 minutes	100	45%	1-4
Applied Project Management - Seminar					

Module Completion Requirements

- **Module Examination:** minimum for pass- 45%.

Module Achievement

None.

5.1.12 International Strategic Management

Module Name	International Strategic Management
Module Code	CO-601
Module ECTS	7.5
Program Owner	IBA-BA (International Business Administration)
Module Coordinator	Dr. Matthias Meckel

Study Semester		
Program	**Semester**	**Status**
IBA-BA International Business Administration	4	Mandatory Elective
IEM-BSc Industrial Engineering & Management	4	Mandatory Elective
Minor-EIM-BSc Minor EIM	4	Mandatory

Student Workload	
Lecture	35
Seminar	17.5
Independent Study	135
Total Hours	**187.5**

Module Components	**Number**	**Type**	**CP**
International Strategic Management	CO-601-A	Lecture	5
International Strategic Management - Seminar	CO-601-B	Seminar	2.5

Module Description

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.

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.

Recommended Knowledge

- Academic writing skills

- Good understanding of the principles of international management

- 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.

Usability and Relationship to other Modules

This module prepares students for the Bachelor Thesis focusing on topics in international management

Intended Learning Outcomes

No	Competence	ILO
1	Identify	Identify and explain critical challenges in strategic management.
2	Develop	Develop a sound understanding of the mechanisms behind international strategic assessments and planning processes.
3	Evaluate	Evaluate and design strategies in international management, such as market selection or entry mode choices.
4	Acquire	Acquire and develop additional knowledge and skills needed to support strategic decision making in international firms.
5	Utilize	Utilize analytical skills and apply relevant tools as required in the discipline.

Indicative Literature

- Morschett, D., Schramm-Klein, H. & Zentes, J. (2015). Strategic International Management – 3rd edition. Wiesbaden: Springer Gabler.
- Verbeke, A. (2013). International Business Strategy – 2nd edition. Cambridge: Cambridge: University Press.

Entry Requirements

Prerequisites	CH-300 Introduction to International Business CH-301 Introduction to Finance and Accounting
Co-requisites	None
Additional Remarks	None

Assessment and Completion

Module Component	Examination Type	Duration or Length	Weight (%)	Minimum for Pass	ILOs
International Strategic Management	Portfolio Assessment (Individual Assignments, Group Assignments)		100	45%	1-5
International Strategic Management - Seminar					

Module Completion Requirements

- **Module Examination:** minimum pass 45%- portfolio.

Module Achievement

None.

5.1.13 Blockchain Technology and Applications

Module Name	Blockchain Technology and Applications
Module Code	CA-S-IBA-805
Module ECTS	5
Program Owner	IBA-BA (International Business Administration)
Module Coordinator	Prof. Dr. Lennart Ante

Study Semester		
Program	**Semester**	**Status**
GEM-BA Global Economics and Management	6	Mandatory Elective
IBA-BA International Business Administration	6	Mandatory Elective
IEM-BSc Industrial Engineering & Management	6	Mandatory Elective
MDDA-BSc Management, Decisions and Data Analytics	6	Mandatory Elective

Student Workload	
Lecture	35
Independent Study	90
Total Hours	**125**

Module Components	**Number**	**Type**	**CP**
Blockchain Technology and Applications	CA-IBA-805	Lecture	5

Module Description

This module introduces blockchain technology and its wide-ranging applications across business and society. It provides a thorough overview of foundational concepts, including the structure and operation of distributed ledgers, the mechanisms of decentralization, and the role of cryptographic security in ensuring data integrity. The course also covers consensus protocols such as Proof of Work and Proof of Stake, along with advanced topics like smart contracts, tokenization, and interoperability. By integrating theoretical knowledge with case studies and examples, the module contextualizes how blockchain technology is reshaping industries such as finance, healthcare, and supply chain management.

Students will engage deeply with blockchain use cases, including cryptocurrencies, non-fungible tokens (NFTs), or decentralized finance (DeFi). Through practical activities, they will learn to set up wallets, create and deploy tokens, and interact with decentralized applications (dApps). These hands-on sessions are designed to provide a functional understanding of blockchain tools, while discussions on challenges such as security, scalability and energy consumption encourage critical thinking about its

broader implications. The module also explores emerging innovations like the integration of blockchain with artificial intelligence.

The course aims to develop practical and theoretical skills that are relevant to job opportunities in the blockchain sector and beyond.

Recommended Knowledge

- Basic understanding of digital technologies and business management

- Students are encouraged to familiarize themselves with fundamental blockchain concepts by exploring online resources

Usability and Relationship to other Modules

This module provides foundational knowledge and hands-on experience in blockchain technology, preparing students for advanced topics in digital transformation, fintech, and entrepreneurship

Intended Learning Outcomes

No	Competence	ILO
1	Explain	Explain the core concepts, architecture, and principles of blockchain technology.
2	Analyze	Analyze the economic, business and societal implications of blockchain applications.
3	Apply	Apply blockchain tools, including digital wallets, tokenization, and transaction verification.
4	Evaluate	Evaluate the potential and limitations of blockchain applications.
5	Propose	Propose blockchain-based solutions to address business and societal challenges, while considering the practical and contextual constraints of their implementation.

Indicative Literature

- Antonopoulos, A. M. (2017). Mastering Bitcoin: Unlocking Digital Cryptocurrencies. O'Reilly Media.
- Nakamoto, S. (2008). Bitcoin: A Peer-to-Peer Electronic Cash System.
- Steinmetz, F., Ante, L. & Fiedler, I. (2020). Blockchain and the digital economy: The socio-economic impact of blockchain technology. Agenda Publishing. https://doi.org/10.2307/j.ctv16qjxg0.

Entry Requirements

Prerequisites	None
Co-requisites	None
Additional Remarks	None

Assessment and Completion

Module Component	Examination Type	Duration or Length	Weight (%)	Minimum for Pass	ILOs
Blockchain Technology and Applications	Term Paper	2500 words	100	45%	1-5

Module Completion Requirements

- **Module Examination:** minimum for pass- 45%.

Module Achievement

None.

5.1.14 Advanced Product Design

Module Name	Advanced Product Design
Module Code	CA-S-IEM-802
Module ECTS	5
Program Owner	IEM-BSc (Industrial Engineering & Management)
Module Coordinator	Prof. Dr. Omid Fatahi Valilai

Study Semester		
Program	**Semester**	**Status**
IEM-BSc Industrial Engineering & Management	6	Mandatory Elective

Student Workload	
Laboratory	17.5
Project Work	45
Total Hours	**62.5**

Module Components	**Number**	**Type**	**CP**
Advanced Product Design	CA-IEM-802	Laboratory	5

Module Description

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.

Recommended Knowledge

3D modelling software

Intended Learning Outcomes

No	**Competence**	**ILO**

1	Explain	Explain and apply the "product development" framework: from clarification of the requirements, through development of the product, to actual manufacturing with a 3D printer.
2	Apply	Apply math, science, and engineering standards to hands-on projects.
3	Utilize	Utilize designs for the development and production of a final project.
4	Implement	Implement problem solving techniques based on specific scenarios.
5	Develop	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.
6	Develop	Develop an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Indicative Literature

- Benhabib, B. (2003). Manufacturing: Design, Production, Automation, and Integration, Marcel Dekker Inc.
- Mitchell, F.H. (1991). CIM Systems: An Introduction to Computer-Integrated Manufacturing", Prentice Hall College Div; 1St Edition edition (January 1991), ISBN: 978-0131332997.
- 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.
- 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.

Entry Requirements

Prerequisites	CO-581 Product & Production System Design
Co-requisites	None
Additional Remarks	None

Assessment and Completion

Module Component	Examination Type	Duration or Length	Weight (%)	Minimum for Pass	ILOs
Advanced Product Design	Project Assessment	group assessment	100	45%	1-6

Module Completion Requirements

- **Module Examination:** minimum for pass- 45%.

Module Achievement

None.

5.1.15 Sustainable Supply Chain Management

Module Name	Sustainable Supply Chain Management
Module Code	CA-S-IEM-809
Module ECTS	2.5
Program Owner	IEM-BSc (Industrial Engineering & Management)
Module Coordinator	Dr. Stanislav Chankov

Study Semester		
Program	**Semester**	**Status**
IEM-BSc Industrial Engineering & Management	6	Mandatory Elective

Student Workload	
Seminar	17.5
Independent Study	45
Total Hours	**62.5**

Module Components	**Number**	**Type**	**CP**
Sustainable Supply Chain Management	CA-IEM-809	Seminar	2.5

Module Description

This module explores the principles and practices of sustainable supply chain management, emphasizing the balance between economic, environmental, and social sustainability. Students will analyze how companies integrate sustainability into their supply chain operations, addressing key topics such as responsible sourcing, circular economy, carbon footprint reduction, and ethical labor practices. The module incorporates case studies and business simulation games to provide experiential learning opportunities. By engaging with real-world challenges, students will develop strategic and analytical skills necessary to implement sustainable supply chain practices in global business environments.

This 2.5 CP module is part of a portfolio of several 2.5 CP modules in order to allow students to have a wider choice of electives. To compensate for the smaller size of this module, the assessment is of smaller scope.

Recommended Knowledge

Revise material on Logistics and Supply Chain Management.

Intended Learning Outcomes

No	**Competence**	**ILO**

1	Analyze	Analyze the key sustainability challenges in modern supply chains, considering environmental, social, and governance (ESG) factors.
2	Analyze	Analyze real-world problems related to sustainable supply chain management
3	Design	Design innovative solutions to existing problems by applying sustainable supply chain frameworks, tools, and models on practical cases
4	Give	Give a presentation on a given problem and derived solution and manage a project under time pressure (basic consulting skills)

Indicative Literature

- Carter, C. R., & Rogers, D. S. (2008). A framework of sustainable supply chain management: Moving toward new theory. International Journal of Physical Distribution & Logistics Management, 38(5), 360-387.
- Grant, B. et al. (2022). Sustainable Logistics and Supply Chain Management. Kogan Page.
- Sarkis, J. (Ed.). (2019). Handbook on the Sustainable Supply Chain. Edward Elgar Publishing.
- Seuring, S., & Müller, M. (2008). From a literature review to a conceptual framework for sustainable supply chain management. Journal of Cleaner Production, 16(15), 1699-1710.

Entry Requirements

Prerequisites	CH-241 General Logistics CO-580 Production Planning & Control
Co-requisites	None
Additional Remarks	None

Assessment and Completion

Module Component	Examination Type	Duration or Length	Weight (%)	Minimum for Pass	ILOs
Sustainable Supply Chain Management	Project Assessment		100	45%	1-4

Module Completion Requirements

- **Module Examination:** minimum for pass- 45%.

Module Achievement

None.

5.1.16 Integrated Decision Making in Supply Chain Management

Module Name	Integrated Decision Making in Supply Chain Management
Module Code	CA-S-IEM-804
Module ECTS	2.5
Program Owner	IEM-BSc (Industrial Engineering & Management)
Module Coordinator	Dr. Stanislav Chankov

Study Semester		
Program	**Semester**	**Status**
IEM-BSc Industrial Engineering & Management	6	Mandatory Elective

Student Workload	
Seminar	17.5
Project Work	45
Total Hours	**62.5**

Module Components	**Number**	**Type**	**CP**
Integrated Decision Making in Supply Chain Management	CA-IEM-804	Seminar	2.5

Module Description

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.

This 2.5 CP module is part of a portfolio of several 2.5 CP modules in order to allow students to have a wider choice of electives. To compensate for the smaller size of this module, the assessment is of smaller scope.

Recommended Knowledge

- Familiarize yourself with the Fresh Connection game and the basics of fruit juice production and distribution.

- Revise basic concepts from logistics and supply chain management.

Intended Learning Outcomes

No	Competence	ILO
1	Formulate	Formulate and explain supply chain strategies.
2	Make	Make decisions in a high-pressure environment as part of a team considering conflicting logistics targets.
3	Evaluate	Evaluate different suppliers and defend appropriate contract terms in a global supply chain environment.
4	Design	Design appropriate techniques for capacity planning in warehouses and production, inventory management, and demand forecasting.
5	Analyze	Analyze the environmental impact of a given supply chain and suggest sustainability improvements.
6	Develop	Develop project management tools to effectively work in teams to perform a task.

Indicative Literature

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

Entry Requirements

Prerequisites	CH-241 General Logistics CO-580 Production Planning & Control
Co-requisites	None
Additional Remarks	None

Assessment and Completion

Module Component	Examination Type	Duration or Length	Weight (%)	Minimum for Pass	ILOs
Integrated Decision Making in Supply Chain Management	Project Assessment		100	45%	1-6

Module Completion Requirements

- **Module Examination:** minimum for pass- 45%.

Module Achievement

None.

5.1.17 Distribution & E-Commerce

Module Name	Distribution & E-Commerce
Module Code	CA-S-IEM-805
Module ECTS	2.5
Program Owner	IEM-BSc (Industrial Engineering & Management)
Module Coordinator	Dr. Mahdi Homayouni

Study Semester		
Program	**Semester**	**Status**
IEM-BSc Industrial Engineering & Management	6	Mandatory Elective

Student Workload	
Lecture	17.5
Project Work	45
Total Hours	**62.5**

Module Components	**Number**	**Type**	**CP**
Distribution & E-Commerce	CA-IEM-805	Lecture	2.5

Module Description

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 consist 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.

This module is intentionally designed as a 2.5 CP module to enhance Employability by exposing students to a variety of professionally relevant topics rather than requiring in-depth specialization.

Recommended Knowledge

Identify major e-commerce companies and read on their distribution strategies and processes.

Intended Learning Outcomes

No	Competence	ILO
1	Explain	Explain how new market trends shape traditional operations and distribution logistics.
2	Describe	Describe and critically evaluate the evolution of e-commerce, its enablers, and new operational challenges in relation to distribution logistics.
3	Evaluate	Evaluate the various challenges warehouses and sorting centers face in fulfilling e-commerce-specific requirements.
4	Discuss	Discuss the growing importance and complexity of last-mile deliveries and novel methods to tackle associated delivery problems.
5	Apply	Apply theoretical models and frameworks from academic studies to analyze problems in practice.
6	Match	Match different types of operational problems with appropriate (technical) solution approaches.
7	Evaluate	Evaluate and working through distribution and e-commerce case studies.

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.

Entry Requirements

Prerequisites	CH-241 General Logistics CH-240 General Industrial Engineering
Co-requisites	None
Additional Remarks	None

Assessment 7and Completion

Module Component	Examination Type	Duration or Length	Weight (%)	Minimum for Pass	ILOs
Distribution & E-Commerce	Project Assessment		100	45%	1-7

Module Completion Requirements

- **Module Examination:** minimum for pass- 45%.

Module Achievement

None.

5.1.18 Purchasing & Supply Management

Module Name	Purchasing & Supply Management
Module Code	CA-S-IEM-810
Module ECTS	2.5
Program Owner	IEM-BSc (Industrial Engineering & Management)
Module Coordinator	Prof. Dr. Florian Schupp

Study Semester		
Program	**Semester**	**Status**
IEM-BSc Industrial Engineering & Management	6	Mandatory Elective

Student Workload	
Seminar	17.5
Independent Study	45
Total Hours	**62.5**

Module Components	**Number**	**Type**	**CP**
Purchasing & Supply Management	CA-IEM-810	Seminar	2.5

Module Description

This module 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, 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.

This 2.5 CP module is part of a portfolio of several 2.5 CP modules in order to allow students to have a wider choice of electives. To compensate for the smaller size of this module, the assessment is of smaller scope.

Recommended Knowledge

Revise material from the 1st year related to purchasing.

Intended Learning Outcomes

No	**Competence**	**ILO**
1	Develop	Develop a sourcing strategy for specific material categories.

2	Explain	Explain how behavioral aspects play a role in buyer-supplier interactions.
3	Design	Design a negotiation strategy based on buyer-supplier power positioning.
4	Apply	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.

Entry Requirements

Prerequisites	CH-300 Introduction to International Business CH-240 General Industrial Engineering CH-241 General Logistics
Co-requisites	None
Additional Remarks	None

Assessment and Completion

Module Component	Examination Type	Duration or Length	Weight (%)	Minimum for Pass	ILOs
Purchasing & Supply Management	Term Paper	2000 words	100	45%	1-4

Module Completion Requirements

- **Module Examination:** minimum for pass- 45%.

Module Achievement

None.

5.1.19 Law of Transportation, Forwarding and Logistics

Module Name	Law of Transportation, Forwarding and Logistics
Module Code	CA-S-IEM-806
Module ECTS	2.5
Program Owner	IEM-BSc (Industrial Engineering & Management)
Module Coordinator	Dr. Stanislav Chankov

Study Semester		
Program	**Semester**	**Status**
IEM-BSc Industrial Engineering & Management	6	Mandatory Elective

Student Workload	
Lecture	17.5
Independent Study	45
Total Hours	**62.5**

Module Components	**Number**	**Type**	**CP**
Law of Transportation, Forwarding and Logistics	CA-IEM-806	Lecture	2.5

Module Description

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.

This 2.5 CP module is part of a portfolio of several 2.5 CP modules in order to allow students to have a wider choice of electives. To compensate for the smaller size of this module, the assessment is of smaller scope.

Recommended Knowledge

Familiarize yourself with basic terms of German labor law and international trade law.

Intended Learning Outcomes

No	Competence	ILO
1	Discuss	Discuss international trade law in the context of logistics and transportation and international private law.
2	Evaluate	Evaluate contracts for transportation, forwarding and logistics activities.
3	Explain	Explain international conventions for the carriage of goods.
4	Analyze	Analyze legal aspects in contract negotiations for logistics or related contracts.

Indicative Literature

- David, P. (2003). International Logistics. Dreamtech Press.

Entry Requirements

Prerequisites	CH-241 General Logistics CH-240 General Industrial Engineering
Co-requisites	None
Additional Remarks	None

Assessment and Completion

Module Component	Examination Type	Duration or Length	Weight (%)	Minimum for Pass	ILOs
Law of Transportation, Forwarding and Logistics	Written Examination	90 minutes	100	45%	1-4

Module Completion Requirements

- **Module Examination:** minimum for pass- 45%.

Module Achievement

None.

5.1.20 Econometrics

Module Name	Econometrics
Module Code	CTMS-MET-05
Module ECTS	5
Program Owner	CT (CONSTRUCTOR Track Area)
Module Coordinator	Prof. Dr. Fabian Dehos

Study Semester		
Program	**Semester**	**Status**
MDDA-BSc Management, Decisions and Data Analytics	3	Mandatory
ESSMER-BSc Earth Sciences and Sustainable Management of Environmental Resources	4	Mandatory
GEM-BA Global Economics and Management	4	Mandatory
IBA-BA International Business Administration	4	Mandatory Elective
IBA-Online-BA International Business Administration (Online)	4	Mandatory
IEM-BSc Industrial Engineering & Management	4	Mandatory Elective

Student Workload	
Independent Study	90
Seminar	35
Total Hours	**125**

Module Components	**Number**	**Type**	**CP**
Econometrics	CTMS-05	Seminar	5

Module Description

This module focuses on the application of econometric methods to the analysis of secondary data. Specifically, the goal is to expose students to some of the issues and challenges typically confronted by econometricians when analyzing empirical data in the realms of social science research, business and finance. Emphasis will be placed on the intuition underlying various commonly applied econometric techniques and on the steps needed to implement them. The module expands on the knowledge acquired in statistics and intensifies discussions of multiple regression analysis. The general objective is to become familiar with contemporary methods that are used in econometric and business analyses and to become a critical reader of case studies. In this regard, a clear distinction will be drawn along two dimensions: between questions of statistical significance versus those of economic or social

significance; and between correlation and causation. The module takes a practical approach that covers how to estimate econometric models using R software. Sessions will often include computer applications to foster understanding of the discussed topics.

Recommended Knowledge

- An accessible overview of regression analysis can be found in Sykes, A.O. (1993). An Introduction to Regression Analysis. Coase-Sandor Institute for Law & Economics, Univ. of Chicago Working Paper No. 20. https://chicagounbound.uchicago.edu/law_and_economics/51/. Students are also encouraged to read: Ziliak, Stephen T. (2008). Retrospectives: Guinnessometrics: The Economic Foundation of "Student's". Journal of Economic Perspectives 22(4): 199-216.

- Knowledge of the ordinary least-squares regression model.

- Ability to estimate regression models using R software.

- Skills in conducting statistical inference tests.

Usability and Relationship to other Modules

- The module is a mandatory / mandatory elective module of the Methods area that is part of the Constructor Track (Methods and New Skills modules; Language and Humanities modules).

- This module builds on models and topics from the first-year modules "Microeconomics" and "Macroeconomics" and from the second-year modules "Environmental and Resource Economics" and "Development Economics"

- 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

- This module prepares students in IBA for the analysis of data in the 2nd year modules International Strategic Management and Marketing and the 3rd year module Contemporary Topics in Marketing and the thesis

- Mandatory for a major in GEM.

- Mandatory elective for a major in IBA

- Elective for all other study programs.

Intended Learning Outcomes

No	Competence	ILO
1	Explain	Explain the mechanics and assumptions underpinning the Ordinary Least Squares (OLS) regression model.
2	Estimate	Estimate an OLS model on secondary data using R-software.
3	Interpret	Interpret the coefficient estimates from an OLS model with respect to their sign and magnitude.
4	Conduct	Conduct one- and two-sided tests of the statistical significance of coefficients.

Indicative Literature

- Abadie, A. & Cattaneo, M.D. (2018). Econometric methods for program evaluation. Annual Review of Economics, 10, 465-503.
- Angrist, J.D. & Pischke, J.S. (2014). Mastering'metrics: The path from cause to effect. Princeton University Press.
- Kabacoff, R. (2015). R in action: Data analysis and graphics with R. Chapter 8. Manning Publications Co.
- Wooldridge, J. M. (2015). Introductory econometrics: A modern approach. 6th edition. Cambridge Learning.
- Ziliak, Stephen T. (2008). Guinnessometrics: The economic foundation of "student's". Journal of Economic Perspectives 22(4), 199-216.

Entry Requirements

Prerequisites	CTMS-MET-03 Applied Statistics with R
Co-requisites	None
Additional Remarks	None

Assessment and Completion

Module Component	Examination Type	Duration or Length	Weight (%)	Minimum for Pass	ILOs
Econometrics	Written Examination	120 Minutes	100	45%	All

Module Completion Requirements

- **Module Examination:** minimum for pass- 45%.

Module Achievement

None.

5.1.21 Machine Learning

Module Name	Machine Learning
Module Code	CO-541
Module ECTS	5
Program Owner	RIS-BSc (Robotics and Intelligent Systems)
Module Coordinator	Prof. Dr. Francesco Maurelli

Study Semester		
Program	**Semester**	**Status**
CS-BSc Computer Science	4	Mandatory Elective
MMDA-BSc Mathematics, Modeling, and Data Analytics	4	Mandatory
PHDS-BSc Physics and Data Science	4	Mandatory Elective
RIS-BSc Robotics and Intelligent Systems	4	Mandatory
SDT-BSc Software, Data and Technology	4	Mandatory
IEM-BSc Industrial Engineering & Management	6	Mandatory Elective

Student Workload	
Class Attendance	35
Exam Preparation	20
Independent Study	70
Total Hours	**125**

Module Components	**Number**	**Type**	**CP**
Machine Learning	CO-541-A	Lecture	5

Module Description

Machine learning (ML) concerns algorithms that are fed with (large quantities of) real-world data, and which return a compressed "model" of the data. An example is the "world model" of a robot; the input data are sensor data streams, from which the robot learns a model of its environment, which is needed, for instance, for navigation. Another example is a spoken language model; the input data are speech recordings, from which ML methods build a model of spoken English; this is useful, for instance, in automated speech recognition systems. There exist many formalisms in which such models can be cast, and an equally large diversity of learning algorithms. However, there is a relatively small number of fundamental challenges that are common to all of these formalisms and algorithms. The lectures introduce such fundamental concepts and illustrate them with a choice of elementary model

formalisms (linear classifiers and regressors, radial basis function networks, clustering, online adaptive filters, neural networks, or hidden Markov models). Furthermore, the lectures also (re-)introduce required mathematical material from probability theory and linear algebra.

Usability and Relationship to other Modules

- This module gives a thorough introduction to the basics of machine learning. It complements the Artificial Intelligence module.

Intended Learning Outcomes

No	Competence	ILO
1	Understand	Understand the notion of probability spaces and random variables
2	Understand	Understand basic linear modeling and estimation techniques
3	Understand	Understand the fundamental nature of the "curse of dimensionality"
4	Understand	Understand the fundamental nature of the bias-variance problem and standard coping strategies
5	Use	Use elementary classification learning methods (linear discrimination, radial basis function networks, multilayer perceptrons)
6	Implement	Implement an end-to-end learning suite, including feature extraction and objective function optimization with regularization based on cross-validation

Indicative Literature

- C. Bishop, Pattern Recognition and Machine Learning, Springer, 2006.
- S. Shalev-Shwartz, Shai Ben-David: Understanding Machine Learning, Cambridge University Press, 2014.
- T. Hastie, R. Tibshirani, J. Friedman, The Elements of Statistical Learning: Data Mining, Inference, and Prediction, 2nd edition, Springer, 2008.
- T.M. Mitchell, Machine Learning, Mc Graw Hill, India, 2017.

Entry Requirements

Prerequisites	None
Co-requisites	None
Additional Remarks	None

Assessment and Completion

Module Component	Examination Type	Duration or Length	Weight (%)	Minimum for Pass	ILOs

Machine Learning	Written Examination	120 Minutes	100	45%	1-6

Module Completion Requirements

- **Module Examination:** minimum for pass- 45%.

Module Achievement

None.

5.1.22 Digital Marketing Fundamentals and SEO

Module Name	Digital Marketing Fundamentals and SEO
Module Code	CTMS-MET-20
Module ECTS	5
Program Owner	CT (CONSTRUCTOR Track Area)
Module Coordinator	Dr. Matthias Meckel

Study Semester		
Program	**Semester**	**Status**
IEM-BSc Industrial Engineering & Management	3	Mandatory Elective
MDDA-BSc Management, Decisions and Data Analytics	3	Mandatory
S-ACS-BSc Applied Computer Science	3	Mandatory Elective
F-ACS-BSc Applied Computer Science	4	Mandatory Elective

Student Workload	
Asynchronous Self Study	80
Independent Study	45
Total Hours	**125**

Module Components	**Number**	**Type**	**CP**
Digital Marketing Fundamentals and SEO	CTMS-20	Lecture	5

Module Description

This module is focused on key aspects of digital marketing and search engine optimisation (SEO), methodologies essential in today's online-driven marketing practice. State-of-the-art digital strategies, data-driven approaches, and SEO techniques will be at the core of the module.

The overall goal of this module is to help students without prior marketing knowledge to learn, understand, and practice the fundamentals of applied digital marketing methodology. This module helps students to navigate today's marketing challenges in a complex, dynamic online environment, where adaptability is essential, and where managers need to focus on achieving strategic goals through effective online presence rather than repetitive tasks.

Students will learn to develop and present consumer-centered and data-driven solutions for real-world digital marketing challenges.

Major challenges and concerns will be reflected:

- The role of data, the customer, and online visibility in a transformed digital landscape

- State-of-the-art digital marketing and SEO techniques

- Ethical and data security considerations in digital marketing

Intended Learning Outcomes

No	Competence	ILO
1	Develop	Develop practical knowledge and digital marketing skills, and mind sets to master address the challenges of today's online markets
2	Understand	Understand (routine) marketing processes in various context and how to state-of-the art digital methodologies to inform marketing decisions
3	Summarize	Summarize and classify the new data- and SEO-focused customer-driven methodologies within a digital marketing context
4	Understand	Understand the idea and potential for value -creation through of consumer-centric, data-informed digital marketingity
5	Apply	Apply innovative digital creativity methods and processes to enhance for marketing effectiveness

Indicative Literature

- Charlesworth (2023): Digital Marketing A Practical Approach, 4th edition
- Dibb, Simkin, Pride Ferrell (2023): Marketing Concepts and Strategies, 9th edition
- Enge, Spencer, Stricchiola (2023): The Art of SEO, 4th edition
- Hanlon (2022): Digital Marketing, 2nd edition
- Kotler (2022): Marketing: An Introduction, 15th edition
- Kotler, Keller, Chernev (2021): Marketing Management, Global Edition, 16th edition.

Entry Requirements

Prerequisites	None
Co-requisites	None
Additional Remarks	None

Assessment and Completion

Module Component	Examination Type	Duration or Length	Weight (%)	Minimum for Pass	ILOs
Digital Marketing Fundamentals and SEO	Presentation	30 minutes	100	45%	1-5

Module Completion Requirements

- **Module Examination:** minimum for pass- 45%.

Module Achievement

None.

5.1.23 Guided Industrial Project / Mandatory Internship

Module Name	Guided Industrial Project / Mandatory Internship
Module Code	CA-INT-901
Module ECTS	30
Program Owner	IEM-BSc (Industrial Engineering & Management)
Module Coordinator	Dr. Tanja Woebs Clémentine Senicourt

Study Semester		
Program	**Semester**	**Status**
IEM-BSc Industrial Engineering & Management	5	Mandatory

Student Workload	
Internship	616
Seminar	20
Internship Event	2
Independent Study	112
Total Hours	**750**

Module Components	**Number**	**Type**	**CP**
Internship IEM	CA-901-0	Internship	30
	CA-901-0		

Module Description

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; 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 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 Student Career Support (SCS). 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 Student Career Support (SCS)(e.g., the annual Constructor University 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 with 15 CP to reduce the full-time internship to 8 weeks (15 CP). 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 by entering 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.

Two separate assessments are justified by the size of the module and the fact that the justification of solutions to problems and arguments (ILO 8) and discussion (ILO 12) also require a verbal assessment.

Recommended Knowledge

- Information provided on CSC pages

- Major specific knowledge and skills

- Reading the information in the menu sections “Internship Information”, “Career Events”, “Create Your Application” and “Seminars & Workshops” at the Career Service Center (CSC) website http://csc-microsite.user.jacobs-university.de/

- Completing all four online tutorials about job market preparation and the application process (http://csc-microsite.user.jacobs-university.de/create-your-application/tutorials/)

- Participation in the Internship Events of earlier classes

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.

Intended Learning Outcomes

No	Competence	ILO
1	Analyze	Analyze industrial problems in a real-world environment
2	Create	Create solutions to real industrial situations applying principles of industrial engineering, business administration, strategy, logistics and supply chain management
3	Communicate	Communicate their conclusions and recommendations in both spoken and written form
4	Describe	Describe the scope and the functions of the employment market and personal career development
5	Apply	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
6	Manage	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)
7	Apply	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
8	Justify	Justify professional decisions based on theoretical knowledge and academic methods
9	Reflect	Reflect on their professional conduct in the context of expectations by and consequences for employers and society
10	Reflect	Reflect on and set targets for further development of their knowledge, skills, interests and values
11	Establish	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

12	Discuss	Discuss observations and reflections in a professional network
13	Analyze	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

Entry Requirements

Prerequisites	None
Co-requisites	None
Additional Remarks	None

Assessment and Completion

Module Component	Examination Type	Duration or Length	Weight (%)	Minimum for Pass	ILOs
Internship IEM	Project Report	3500 words		Pass/Fail	All
	Poster Presentation	10-15 minutes; 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)			All

		should at least have verbal elements. The weights of the assessments are commensurate with the sizes of the respective module components.			

Module Completion Requirements

- **Module Examination:** pass/fail grading.

Module Achievement

None.

5.1.24 Bachelor Thesis and Seminar IEM

Module Name	Bachelor Thesis and Seminar IEM
Module Code	CA-IEM-800
Module ECTS	15
Program Owner	IEM-BSc (Industrial Engineering & Management)
Module Coordinator	Study Program Chair

Study Semester		
Program	**Semester**	**Status**
IEM-BSc Industrial Engineering & Management	6	Mandatory

Student Workload	
Independent Study/Laboratory Work	350
Seminar	25
Total Hours	**375**

Module Components	**Number**	**Type**	**CP**
Thesis IEM	CA-IEM-800-T	Thesis	12
Thesis Seminar IEM	CA-IEM-800-S	Seminar	3

Module Description

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 Constructor 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.

Recommended Knowledge

- Comprehensive knowledge of the subject and deeper insight into the chosen topic

- Ability to plan and undertake work independently

- Skills needed to identify and critically review literature

- Identify an area or a topic of interest and discuss this with your prospective supervisor in a timely manner.

- Create a research proposal including a research plan to ensure timely submission.

- Ensure you possess all required technical research skills or are able to acquire them on time.

- Review the University's Code of Academic Integrity and Guidelines to Ensure Good Academic Practice

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.

Intended Learning Outcomes

No	Competence	ILO
1	Plan	Plan and organize advanced learning processes
2	Design	Design and implement appropriate research methods taking full account of the range of alternative techniques and approaches
3	Collect	Collect, assess and interpret relevant information
4	Draw	Draw scientifically founded conclusions that consider social, scientific and ethical insights
5	Apply	Apply their knowledge and understanding to a context of their choice
6	Develop	Develop, formulate and advance solutions to problems and arguments in their subject area, and defend these through argument
7	Discuss	Discuss information, ideas, problems and solutions with specialists and non-specialists

Indicative Literature

Entry Requirements

Prerequisites	Students must have taken and successfully passed a total of at least 30 CP from advanced modules, and of those, at least 20 CP from advanced modules in the major

Co-requisites	None
Additional Remarks	None

Assessment and Completion

Module Component	Examination Type	Duration or Length	Weight (%)	Minimum for Pass	ILOs
Thesis IEM	Thesis	approx. 6.000 – 8.000 words (25 –35 pages), excluding front- and back matter; 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	80	45%	1-6

		. The weights of the types of assessments are commensurate with the sizes of the respective module components.			
Thesis Seminar IEM	Presentation	Approx. 15 to 30 minutes	20	45%	6-7

Module Completion Requirements

- **Module Component Examination:** minimum pass 45% of each assessment.

Module Achievement

None.

6 Constructor Track Modules

6.1 Methods Modules

6.1.1 Applied Calculus

Module Name	Applied Calculus
Module Code	CTMS-MAT-08
Module ECTS	5
Program Owner	CT (CONSTRUCTOR Track Area)
Module Coordinator	Prof. Dr. Igors Gorbovickis

Study Semester		
Program	**Semester**	**Status**
GEM-BA Global Economics and Management	1	Mandatory
IBA-BA International Business Administration	1	Mandatory
IBA-Online-BA International Business Administration (Online)	1	Mandatory
IEM-BSc Industrial Engineering & Management	1	Mandatory
IEM-Online-BSc Industrial Engineering & Management (Online)	1	Mandatory
MDDA-BSc Management, Decisions and Data Analytics	1	Mandatory

Student Workload	
Lecture	35
Independent Study	90
Total Hours	**125**

Module Components	**Number**	**Type**	**CP**
Applied Calculus	CTMS-08	Lecture	5

Module Description

This module 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.

The lecture comprises the following topics:

- Brief review of elementary functions and their graphs

- 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

Usability and Relationship to other 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.

Recommended Knowledge

- 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).

- Some familiarity with elementary calculus (limits, derivatives) is helpful, but not required

Intended Learning Outcomes

No	Competence	ILO
1	Apply	Apply the fundamental concepts of Calculus in structured situations.
2	Command	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.
3	Explain	Explain importance of the methods of Calculus in problems arising from applications.
4	Understand	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.

Entry Requirements

Prerequisites	None
Co-requisites	None
Additional Remarks	None

Assessment and Completion

Module Component	Examination Type	Duration or Length	Weight (%)	Minimum for Pass	ILOs
Applied Calculus	Written Examination	120 Minutes	100	45%	All

Module Completion Requirements

- **Module Examination:** minimum for pass- 45%.

Module Achievement

None.

Module Name	Introduction to Philosophical Ethics
Module Code	CTHU-HUM-001
Module ECTS	2.5
Program Owner	CT (CONSTRUCTOR Track Area)
Module Coordinator	Dr. Eoin Ryan

Study Semester		
Program	**Semester**	**Status**
BCCB-BSc Biochemistry and Cell Biology	1	Mandatory Elective
CBT-BSc Chemistry and Biotechnology	1	Mandatory Elective
CS-BSc Computer Science	1	Mandatory Elective
ECE-BSc Electrical and Computer Engineering	1	Mandatory Elective
ESSMER-BSc Earth Sciences and Sustainable Management of Environmental Resources	1	Mandatory Elective
IBA-BA International Business Administration	1	Mandatory Elective
IBA-Online-BA International Business Administration (Online)	1	Mandatory Elective
IEM-BSc Industrial Engineering & Management	1	Mandatory Elective
IEM-Online-BSc Industrial Engineering & Management (Online)	1	Mandatory Elective
IRPH-BA International Relations: Politics and History	1	Mandatory Elective
ISCP-BA Integrated Social and Cognitive Psychology	1	Mandatory Elective
MCCB-BSc Medicinal Chemistry and Chemical Biology	1	Mandatory Elective
MDDA-BSc Management, Decisions and Data Analytics	1	Mandatory Elective
MMDA-BSc Mathematics, Modeling, and Data Analytics	1	Mandatory Elective
PHDS-BSc Physics and Data Science	1	Mandatory Elective
RIS-BSc Robotics and Intelligent Systems	1	Mandatory Elective
SDT-BSc Software, Data and Technology	1	Mandatory Elective

BCCB-BSc Biochemistry and Cell Biology	2	Mandatory Elective
CBT-BSc Chemistry and Biotechnology	2	Mandatory Elective
CS-BSc Computer Science	2	Mandatory Elective
ECE-BSc Electrical and Computer Engineering	2	Mandatory Elective
ESSMER-BSc Earth Sciences and Sustainable Management of Environmental Resources	2	Mandatory Elective
GEM-BA Global Economics and Management	2	Mandatory Elective
IBA-BA International Business Administration	2	Mandatory Elective
IBA-Online-BA International Business Administration (Online)	2	Mandatory Elective
IEM-Online-BSc Industrial Engineering & Management (Online)	2	Mandatory Elective
IRPH-BA International Relations: Politics and History	2	Mandatory Elective
ISCP-BA Integrated Social and Cognitive Psychology	2	Mandatory Elective
MCCB-BSc Medicinal Chemistry and Chemical Biology	2	Mandatory Elective
MDDA-BSc Management, Decisions and Data Analytics	2	Mandatory Elective
MMDA-BSc Mathematics, Modeling, and Data Analytics	2	Mandatory Elective
PHDS-BSc Physics and Data Science	2	Mandatory Elective
RIS-BSc Robotics and Intelligent Systems	2	Mandatory Elective
SDT-BSc Software, Data and Technology	2	Mandatory Elective

Student Workload	
Independent Study	45
Online Lecture	17.5
Total Hours	**62.5**

Module Components	**Number**	**Type**	**CP**
Introduction to Philosophical Ethics	CTHU-001	Lecture (Online)	2.5

Module Description

The nature of morality - how to lead a life that is good for yourself, and how to be good towards others - has been a central debate in philosophy since the time of Socrates, and it is a topic that continues to be vigorously discussed. This course will introduce students to some of the key aspects of philosophical ethics, including leading normative theories of ethics (e.g. consequentialism or utilitarianism, deontology, virtue ethics, natural law ethics, egoism) as well as some important questions from metaethics (are useful and generalizable ethical claims even possible; what do ethical speech and ethical judgements actually do or explain) and moral psychology (how do abstract ethical principles do when realized by human psychologies). The course will describe ideas that are key factors in ethics (free will, happiness, responsibility, good, evil, religion, rights) and indicate various routes to progress in understanding ethics, as well as some of their difficulties.

This 2.5 CP module is part of a portfolio of several 2.5 CP modules designed to allow students to have a wider choice of electives. To compensate for the smaller size of this module, the assessment is of smaller scope.

Intended Learning Outcomes

No	Competence	ILO
1	Describe	Describe normative ethical theories such as consequentialism, deontology and virtue ethics.
2	Discuss	Discuss some metaethical concerns.
3	Analyze	Analyze ethical language.
4	Highlight	Highlight complexities and contradictions in typical ethical commitments.
5	Indicate	Indicate common parameters for ethical discussions at individual and social levels.
6	Analyze	Analyze notions such as objectivity, subjectivity, universality, pluralism, value.

Indicative Literature

- Mark van Roojen Metaethicas: A Contemporary Introduction (2015).
- Russ Shafer-Landay A Concise Introduction to Ethics (2019).
- Simon Blackburn Being Good (2009).

Entry Requirements

Prerequisites	None
Co-requisites	None
Additional Remarks	None

Assessment and Completion

Module Component	Examination Type	Duration or Length	Weight (%)	Minimum for Pass	ILOs
Introduction to Philosophical Ethics	Written Examination	60 Minutes	100	45%	1-6

Module Completion Requirements

- **Module Examination:** pass/fail grading.

Module Achievement

None.

6.1.2 General Industrial Engineering

Module Name	General Industrial Engineering
Module Code	CH-240
Module ECTS	7.5
Program Owner	IEM-BSc (Industrial Engineering & Management)
Module Coordinator	Dr. Georgi Dragolov Prof. Dr. Omid Fatahi Valilai

Study Semester		
Program	**Semester**	**Status**
IEM-BSc Industrial Engineering & Management	2	Mandatory
Minor-IEM Minor Option in IEM	2	Mandatory

Student Workload	
Lecture	35
Laboratory	17.5
Independent Study	90
Group Discussion	45
Total Hours	**187.5**

Module Components	**Number**	**Type**	**CP**
Industrial Engineering	CH-240-A	Lecture	5
Basics of Manufacturing Technology	CH-240-B	Laboratory	2.5

Module Description

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 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.

A single assessment type cannot sufficiently test all intended learning outcomes. The project report evaluates practical skills on Engineering Drawing, BOM, OPC creation and Time and motion study execution, whereas the written examination assesses understanding of core concepts, principles, and analytical reasoning for Industrial Engineering.

Recommended Knowledge

- 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.

Intended Learning Outcomes

No	Competence	ILO
1	Comprehend	Comprehend the main responsibilities of industrial engineering.
2	Understand	Understand and manage the whole process from product design to manufacturing.
3	Choose	Choose basic materials (e.g., steel) for different types of products.
4	Prepare	Prepare simple engineering drawings.
5	Calculate	Calculate the required number of machines for a given scope of manufacturing requirements.
6	Understand	Understand the importance of ergonomics and ergonomic workplace design.
7	Apply	Apply several scheduling techniques for production planning and control.
8	Reflect	Reflect on the applicability of current developments and trends in industrial engineering.

9	Describe	Describe the main manufacturing processes such casting, milling, welding, grinding, and the state-of-the-art tools and technologies used in these processes.
10	Apply	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.

Entry Requirements

Prerequisites	None
Co-requisites	None
Additional Remarks	None

Assessment and Completion

Module Component	Examination Type	Duration or Length	Weight (%)	Minimum for Pass	ILOs
Industrial Engineering	Written Examination	180 minutes	67	45%	1-9
Basics of Manufacturing Technology	Project Assessment	group assessment	33	45%	9-10

Module Completion Requirements

- **Module Component Examination:** minimum pass 45% of each assessment.

Module Achievement

None.

6.1.3 Introduction to the Philosophy of Science

Module Name	Introduction to the Philosophy of Science
Module Code	CTHU-HUM-002
Module ECTS	2.5
Program Owner	CT (CONSTRUCTOR Track Area)
Module Coordinator	Dr. Eoin Ryan

Study Semester		
Program	**Semester**	**Status**
BCCB-BSc Biochemistry and Cell Biology	1	Mandatory Elective
CBT-BSc Chemistry and Biotechnology	1	Mandatory Elective
CS-BSc Computer Science	1	Mandatory Elective
ECE-BSc Electrical and Computer Engineering	1	Mandatory Elective
ESSMER-BSc Earth Sciences and Sustainable Management of Environmental Resources	1	Mandatory Elective
GEM-BA Global Economics and Management	1	Mandatory Elective
IBA-BA International Business Administration	1	Mandatory Elective
IBA-Online-BA International Business Administration (Online)	1	Mandatory Elective
IEM-Online-BSc Industrial Engineering & Management (Online)	1	Mandatory Elective
IRPH-BA International Relations: Politics and History	1	Mandatory Elective
ISCP-BA Integrated Social and Cognitive Psychology	1	Mandatory Elective
MCCB-BSc Medicinal Chemistry and Chemical Biology	1	Mandatory Elective
MDDA-BSc Management, Decisions and Data Analytics	1	Mandatory Elective
MMDA-BSc Mathematics, Modeling, and Data Analytics	1	Mandatory Elective
PHDS-BSc Physics and Data Science	1	Mandatory Elective
RIS-BSc Robotics and Intelligent Systems	1	Mandatory Elective
SDT-BSc Software, Data and Technology	1	Mandatory Elective

BCCB-BSc Biochemistry and Cell Biology	2	Mandatory Elective
CBT-BSc Chemistry and Biotechnology	2	Mandatory Elective
CS-BSc Computer Science	2	Mandatory Elective
ECE-BSc Electrical and Computer Engineering	2	Mandatory Elective
ESSMER-BSc Earth Sciences and Sustainable Management of Environmental Resources	2	Mandatory Elective
IBA-BA International Business Administration	2	Mandatory Elective
IBA-Online-BA International Business Administration (Online)	2	Mandatory Elective
IEM-BSc Industrial Engineering & Management	2	Mandatory Elective
IEM-Online-BSc Industrial Engineering & Management (Online)	2	Mandatory Elective
IRPH-BA International Relations: Politics and History	2	Mandatory Elective
ISCP-BA Integrated Social and Cognitive Psychology	2	Mandatory Elective
MCCB-BSc Medicinal Chemistry and Chemical Biology	2	Mandatory Elective
MDDA-BSc Management, Decisions and Data Analytics	2	Mandatory Elective
MMDA-BSc Mathematics, Modeling, and Data Analytics	2	Mandatory Elective
PHDS-BSc Physics and Data Science	2	Mandatory Elective
RIS-BSc Robotics and Intelligent Systems	2	Mandatory Elective
SDT-BSc Software, Data and Technology	2	Mandatory Elective

Student Workload	
Independent Study	45
Online Lecture	17.5
Total Hours	**62.5**

Module Components	**Number**	**Type**	**CP**
Introduction to the Philosophy of Science	CTHU-002	Lecture (Online)	2.5

Module Description

This humanities module will introduce students to some of the central ideas in philosophy of science. Topics will include distinguishing science from pseudo-science, types of inference and the problem of induction, the pros and cons of realism and anti-realism, the role of explanation, the nature of scientific change, the difference between natural and social sciences, scientism and the values of science, as well as some examples from philosophy of the special sciences (e.g., physics, biology).

The course aims to give students an understanding of how science produces knowledge, and some of the various contexts and issues which mean this process is never entirely transparent, neutral, or unproblematic. Students will gain a critical understanding of science as a human practice and technology; this will enable them both to better understand the importance and success of science, but also how to properly critique science when appropriate.

This 2.5 CP module is part of a portfolio of several 2.5 CP modules designed to allow students to have a wider choice of electives. To compensate for the smaller size of this module, the assessment is of smaller scope.

Intended Learning Outcomes

No	Competence	ILO
1	Understand	Understand key ideas from the philosophy of science.
2	Discuss	Discuss different types of inference and rational processes.
3	Describe	Describe differences between how the natural sciences, social sciences and humanities discover knowledge.
4	Identify	Identify ways in which science can be more and less value-laden.
5	Illustrate	Illustrate some important conceptual leaps in the history of science.

Indicative Literature

- James Ladyman, Understanding Philosophy of Science (2002).
- Paul Song, Philosophy of Science: Perspectives from Scientists (2022).
- Peter Godfrey-Smith Theory and Reality (2021)

Entry Requirements

Prerequisites	None
Co-requisites	None
Additional Remarks	None

Assessment and Completion

Module Component	Examination Type	Duration or Length	Weight (%)	Minimum for Pass	ILOs
Introduction to the Philosophy of Science	Written Examination	60 Minutes	100	45%	1-5

Module Completion Requirements

- **Module Examination:** minimum for pass- 45%.

Module Achievement

None.

6.1.4 Finite Mathematics

Module Name	Finite Mathematics
Module Code	CTMS-MAT-11
Module ECTS	5
Program Owner	CT (CONSTRUCTOR Track Area)
Module Coordinator	Prof. Dr. Igors Gorbovickis

Study Semester		
Program	**Semester**	**Status**
IEM-BSc Industrial Engineering & Management	2	Mandatory
IEM-Online-BSc Industrial Engineering & Management (Online)	2	Mandatory

Student Workload	
Lecture	35
Independent Study	90
Total Hours	**125**

Module Components	**Number**	**Type**	**CP**
Finite Mathematics	CTMS-11	Lecture	5

Module Description

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

Recommended Knowledge

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 Constructor University first-semester modules Mathematical Concepts in the Sciences, Applied Calculus, or Calculus and Elements of Linear Algebra I.

2) Review -the following topics at high school or elementary university level:

- Elementary solution strategies for systems of linear equations

- Solution of quadratic equations

- Factorization of polynomials

- Equations of lines

- Elementary notions of probability

Usability and Relationship to other Modules

- This module serves as a preparation for the 2nd year IEM CORE module Operations Research.

- This module is accessible to all Constructor University 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.

Intended Learning Outcomes

No	Competence	ILO
1	Apply	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.
2	Recognize	Recognize the mathematical structures in an unfamiliar context and translate them into a mathematical problem statement.
3	Recognize	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.

Entry Requirements

Prerequisites	None
Co-requisites	None
Additional Remarks	None

Assessment and Completion

Module Component	Examination Type	Duration or Length	Weight (%)	Minimum for Pass	ILOs
Finite Mathematics	Written Examination	120 Minutes	100	45%	1-3

Module Completion Requirements

- **Module Examination:** minimum for pass- 45%.

Module Achievement

None.

6.1.5 Programming in Python

Module Name	Programming in Python
Module Code	CTMS-SKI-14
Module ECTS	5
Program Owner	CT (CONSTRUCTOR Track Area)
Module Coordinator	Dr. Kinga Lipskoch

Study Semester		
Program	**Semester**	**Status**
IEM-Online-BSc Industrial Engineering & Management (Online)	1	Mandatory
IEM-BSc Industrial Engineering & Management	3	Mandatory

Student Workload	
Class Attendance	35
Independent Study	85
Exam Preparation	5
Total Hours	**125**

Module Components	**Number**	**Type**	**CP**
Programming in Python	CTMS-14	Lecture	5

Module Description

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.

Recommended Knowledge

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.

Intended Learning Outcomes

No	Competence	ILO
1	Explain	Explain basic concepts of imperative programming languages such as variables, assignments, loops, function calls, data structures.
2	Work	Work with user input from the keyboard, and write interactive Python programs.
3	Write	Write, test, and debug programs.
4	Illustrate	Illustrate basic object-oriented programming concepts such as objects, classes, information hiding, and inheritance.
5	Give	Give original examples of function and operator overloading.
6	Retrieve	Retrieve data and process and generate data from/to files.
7	Use	Use some available Python modules and libraries such as those related to data or graphics.

Indicative Literature

- Cay Horsmann, Rance D. Necaise (2014). Python for Everyone. Hoboken: Wiley.
- Igor Milovanovic (2013). Python Data Visualization Cookbook. Birmingham: Packt Publishing.
- John Zelle (2009). Python Programming: An introduction to Computer Science, second edition. Portland: Franklin, Beedle & Associates.
- 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.

Entry Requirements

Prerequisites	None
Co-requisites	None
Additional Remarks	None

Assessment and Completion

Module Component	Examination Type	Duration or Length	Weight (%)	Minimum for Pass	ILOs
Programming in Python	Written Examination	120 Minutes	100	45%	1-7

Module Completion Requirements

- **Module Examination:** minimum for pass- 45%.

Module Achievement

The module achievement ensures that a sufficient level of practical programming skills has been obtained before attempting the exam. The module achievement requires solving and submitting weekly assignment sheets with programming exercises. In order to obtain the module achievement (and to sit for the final exam), it is necessary to collect at least 50% of points. The module achievement is considered fulfilled on a pass/non pass basis and does not impact the overall module grade. An additional assignment sheet is offered in January to make up for missing points (enhancement of the module achievement).

6.1.6 Applied Statistics with R

Module Name	Applied Statistics with R
Module Code	CTMS-MET-03
Module ECTS	5
Program Owner	CT (CONSTRUCTOR Track Area)
Module Coordinator	Prof. Dr. Adalbert F.X. Wilhelm

Study Semester		
Program	**Semester**	**Status**
ESSMER-BSc Earth Sciences and Sustainable Management of Environmental Resources	2	Mandatory
GEM-BA Global Economics and Management	2	Mandatory
IBA-BA International Business Administration	2	Mandatory Elective
IBA-Online-BA International Business Administration (Online)	2	Mandatory
IEM-BSc Industrial Engineering & Management	2	Mandatory
IEM-Online-BSc Industrial Engineering & Management (Online)	2	Mandatory
IRPH-BA International Relations: Politics and History	2	Mandatory Elective
ISCP-BA Integrated Social and Cognitive Psychology	2	Mandatory
MDDA-BSc Management, Decisions and Data Analytics	2	Mandatory

Student Workload	
Assessment Preparation	10
Lecture	17.5
Independent Study	80
Laboratory	17.5
Total Hours	**125**

Module Components	**Number**	**Type**	**CP**
Applied Statistics with R	CTMS-03	Lecture and Laboratory	5

Module Description

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.

Recommended Knowledge

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

Usability and Relationship to other 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 module on advanced econometrics

Intended Learning Outcomes

No	Competence	ILO
1	Apply	Apply basic techniques in statistical modeling and quantitative research methods.
2	Describe	Describe fundamental statistical concepts, procedures, their assumptions and statistical fallacies.
3	Explain	Explain the potential of using quantitative methods in all fields of applications.
4	Express	Express informed skepticism of the limitations of statistical reasoning.
5	Interpret	Interpret statistical modeling results in scientific publications.
6	Perform	Perform basic and intermediate-level statistical analyses of data, using R.

Indicative Literature

- Charles Wheelan (2013). Naked Statistics: Stripping the Dread from The Data. New York: W.W. Norton & Company.
- Christopher Gandrud (2015). Reproducible Research with R and RStudio, Second Edition. The R Series, Chapman & Hall/CRC Press.
- 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.
- Michael J. Crawley (2013). The R Book, Second Edition. Hoboken: John Wiley & Sons.
- Peter Daalgard (2008). Introductory Statistics with R. Berlin: Springer.
- Randall E. Schumacker (2014). Learning Statistics Using R. Thousand Oaks: Sage.

Entry Requirements

Prerequisites	None
Co-requisites	None
Additional Remarks	None

Assessment and Completion

Module Component	Examination Type	Duration or Length	Weight (%)	Minimum for Pass	ILOs
Applied Statistics with R	Written Examination	120 Minutes	100	45%	All

Module Completion Requirements

- **Module Examination:** minimum for pass- 45%.

Module Achievement

None.

6.2 New Skills

6.2.1 Logic (perspective I)

Module Name	Logic (perspective I)
Module Code	CTNS-NSK-01
Module ECTS	2.5
Program Owner	CT (CONSTRUCTOR Track Area)
Module Coordinator	Dr. Marina Christodoulou

Study Semester		
Program	**Semester**	**Status**
BCCB-BSc Biochemistry and Cell Biology	3	Mandatory Elective
CBT-BSc Chemistry and Biotechnology	3	Mandatory Elective
CS-BSc Computer Science	3	Mandatory Elective
ECE-BSc Electrical and Computer Engineering	3	Mandatory Elective
ESSMER-BSc Earth Sciences and Sustainable Management of Environmental Resources	3	Mandatory Elective
F-ACS-BSc Applied Computer Science	3	Mandatory Elective
GEM-BA Global Economics and Management	3	Mandatory Elective
IBA-BA International Business Administration	3	Mandatory Elective
IEM-BSc Industrial Engineering & Management	3	Mandatory Elective
IEM-Online-BSc Industrial Engineering & Management (Online)	3	Mandatory Elective
IRPH-BA International Relations: Politics and History	3	Mandatory Elective
ISCP-BA Integrated Social and Cognitive Psychology	3	Mandatory Elective
MCCB-BSc Medicinal Chemistry and Chemical Biology	3	Mandatory Elective
MDDA-BSc Management, Decisions and Data Analytics	3	Mandatory Elective
MMDA-BSc Mathematics, Modeling, and Data Analytics	3	Mandatory Elective

PHDS-BSc Physics and Data Science	3	Mandatory Elective
RIS-BSc Robotics and Intelligent Systems	3	Mandatory Elective
SDT-BSc Software, Data and Technology	3	Mandatory Elective
IRPH-BA International Relations: Politics and History	4	Mandatory Elective
ISCP-BA Integrated Social and Cognitive Psychology	4	Mandatory Elective
S-ACS-BSc Applied Computer Science	4	Mandatory Elective

Student Workload	
Tutorial	17.5
Independent Study	27.5
Online Lecture	17.5
Total Hours	**62.5**

Module Components	**Number**	**Type**	**CP**
Logic (perspective I)	CTNS-01	Lecture (Online)	2.5

Module Description

Suppose a friend asks you to help solve a complicated problem? Where do you begin? Arguably, the first and most difficult task you face is to figure out what the heart of the problem actually is. In doing that you will look for structural similarities between the problem posed and other problems that arise in different fields that others may have addressed successfully. Those similarities may point you to a pathway for resolving the problem you have been asked to solve. But it is not enough to look for structural similarities. Sometimes relying on similarities may even be misleading. Once you've settled tentatively on what you take to be the heart of the matter, you will naturally look for materials, whether evidence or arguments, that you believe is relevant to its potential solution. But the evidence you investigate of course depends on your formulation of the problem, and your formulation of the problem likely depends on the tools you have available - including potential sources of evidence and argumentation. You cannot ignore this interactivity, but you can't allow yourself to be hamstrung entirely by it. But there is more. The problem itself may be too big to be manageable all at once, so you will have to explore whether it can be broken into manageable parts and if the information you have bears on all or only some of those parts. And later you will face the problem of whether the solutions to the particular sub problems can be put together coherently to solve the entire problem taken as a whole.

What you are doing is what we call engaging in computational thinking. There are several elements of computational thinking illustrated above. These include: Decomposition (breaking the larger problem down into smaller ones); Pattern recognition (identifying structural similarities); Abstraction (ignoring irrelevant particulars of the problem): and Creating Algorithms), problem-solving formulas.

But even more basic to what you are doing is the process of drawing inferences from the material you have. After all, how else are you going to create a problem-solving formula, if you draw incorrect inferences about what information has shown and what, if anything follows logically from it. What you must do is apply the rules of logic to the information to draw inferences that are warranted.

We distinguish between informal and formal systems of logic, both of which are designed to indicate fallacies as well as warranted inferences. If I argue for a conclusion by appealing to my physical ability to coerce you, I prove nothing about the truth of what I claim. If anything, by doing so I display my lack of confidence in my argument. Or if the best I can do is berate you for your skepticism, I have done little more than offer an ad hominem instead of an argument. Our focus will be on formal systems of logic, since they are at the heart of both scientific argumentation and computer developed algorithms. There are in fact many different kinds of logic and all figure to varying degrees in scientific inquiry. There are inductive types of logic, which purport to formalize the relationship between premises that if true offer evidence on behalf of a conclusion and the conclusion and are represented as claims about the extent to which the conclusion is confirmed by the premises. There are deductive types of logic, which introduce a different relationship between premise and conclusion. These variations of logic consist in rules that if followed entail that if the premises are true then the conclusion too must be true.

There are also modal types of logic which are applied specifically to the concepts of necessity and possibility, and thus to the relationship among sentences that include either or both those terms. And there is also what are called deontic logic, a modification of logic that purport to show that there are rules of inference that allow us to infer what we ought to do from facts about the circumstances in which we find ourselves. In the natural and social sciences most of the emphasis has been placed on inductive logic, whereas in math it is placed on deductive logic, and in modern physics there is an increasing interest in the concepts of possibility and necessity and thus in modal logic. The humanities, especially normative discussions in philosophy and literature are the province of deontic logic.

This module will also take students through the central aspects of computational thinking, as it is related to logic; it will introduce the central concepts in each, their relationship to one another and begin to provide the conceptual apparatus and practical skills for scientific inquiry and research.

This 2.5 CP module supports Academic Excellence by providing essential contextual knowledge that underpins the program's qualification aims, while appropriately limiting academic depth relative to the core technical competencies of the field

Intended Learning Outcomes

No	Competence	ILO
1	Apply	Apply the various principles of logic and expand them to computational thinking.
2	Understand	Understand the way in which logical processes in humans and in computers are similar and different at the same time.
3	Apply	Apply the basic rules of first-order deductive logic and employ them rules in the context of creating a scientific or social scientific study and argument.
4	Employ	Employ those rules in the context of creating a scientific or social scientific study and argument.

Indicative Literature

- Frege, Gottlob (1879), Begriffsschrift, eine der arithmetischen nachgebildete Formelsprache des reinen Denkens [Translation: A Formal Language for Pure Thought Modeled on that of Arithmetic], Halle an der Salle: Verlag von Louis Nebert.
- Gödel, Kurt (1986), Russels mathematische Logik. In: Alfred North Whitehead, Bertrand Russell: Principia Mathematica. Vorwort, S. V–XXXIV. Suhrkamp.
- Kubica, Jeremy. Computational fairy tales. Jeremy Kubica, 2012.
- Leeds, Stephen. "George Boolos and Richard Jeffrey. Computability and logic. Cambridge University Press, New York and London1974, x+ 262 pp." The Journal of Symbolic Logic 42.4 (1977): 585-586.
- McCarthy, Timothy. "Richard Jeffrey. Formal logic: Its scope and limits. of XXXVIII 646. McGraw-Hill Book Company, New York etc. 1981, xvi+ 198 pp." The Journal of Symbolic Logic 49.4 (1984): 1408-1409.

Entry Requirements

Prerequisites	None
Co-requisites	None
Additional Remarks	None

Assessment and Completion

Module Component	Examination Type	Duration or Length	Weight (%)	Minimum for Pass	ILOs
Logic (perspective I)	Written Examination	60 Minutes	100	45%	All

Module Completion Requirements

- **Module Examination:** minimum for pass- 45%.

Module Achievement

None.

6.2.2 Logic (perspective II)

Module Name	Logic (perspective II)
Module Code	CTNS-NSK-02
Module ECTS	2.5
Program Owner	CT (CONSTRUCTOR Track Area)
Module Coordinator	Prof. Dr. Jules Coleman

Study Semester		
Program	**Semester**	**Status**
BCCB-BSc Biochemistry and Cell Biology	3	Mandatory Elective
CBT-BSc Chemistry and Biotechnology	3	Mandatory Elective
CS-BSc Computer Science	3	Mandatory Elective
ECE-BSc Electrical and Computer Engineering	3	Mandatory Elective
ESSMER-BSc Earth Sciences and Sustainable Management of Environmental Resources	3	Mandatory Elective
F-ACS-BSc Applied Computer Science	3	Mandatory Elective
GEM-BA Global Economics and Management	3	Mandatory Elective
IBA-BA International Business Administration	3	Mandatory Elective
IBA-Online-BA International Business Administration (Online)	3	Mandatory Elective
IEM-BSc Industrial Engineering & Management	3	Mandatory Elective
IEM-Online-BSc Industrial Engineering & Management (Online)	3	Mandatory Elective
IRPH-BA International Relations: Politics and History	3	Mandatory Elective
ISCP-BA Integrated Social and Cognitive Psychology	3	Mandatory Elective
MCCB-BSc Medicinal Chemistry and Chemical Biology	3	Mandatory Elective
MDDA-BSc Management, Decisions and Data Analytics	3	Mandatory Elective
MMDA-BSc Mathematics, Modeling, and Data Analytics	3	Mandatory Elective
PHDS-BSc Physics and Data Science	3	Mandatory Elective

RIS-BSc Robotics and Intelligent Systems	3	Mandatory Elective
SDT-BSc Software, Data and Technology	3	Mandatory Elective
IRPH-BA International Relations: Politics and History	4	Mandatory Elective
ISCP-BA Integrated Social and Cognitive Psychology	4	Mandatory Elective
S-ACS-BSc Applied Computer Science	4	Mandatory Elective

Student Workload	
Independent Study	45
Online Lecture	17.5
Total Hours	**62.5**

Module Components	**Number**	**Type**	**CP**
Logic (perspective II)	CTNS-02	Lecture (Online)	2.5

Module Description

The focus of this module is on formal systems of logic, since they are at the heart of both scientific argumentation and computer developed algorithms. There are in fact many kinds of logic and all figure to varying degrees in scientific inquiry. There are inductive types of logic, which purport to formalize the relationship between premises that if true offer evidence on behalf of a conclusion and the conclusion and are represented as claims about the extent to which the conclusion is confirmed by the premises. There are deductive types of logic, which introduce a different relationship between premise and conclusion. These variations of logic consist in rules that if followed entail that if the premises are true then the conclusion too must be true.

This module introduces logics that go beyond traditional deductive propositional logic and predicate logic and as such it is aimed at students who are already familiar with basics of traditional formal logic. The aim of the module is to provide an overview of alternative logics and to develop a sensitivity that there are many different logics that can provide effective tools for solving problems in specific application domains.

The module first reviews the principles of a traditional logic and then introduces many-valued logics that distinguish more than two truth values, for example true, false, and unknown. Fuzzy logic extends traditional logic by replacing truth values with real numbers in the range 0 to 1 that are expressing how strong the believe into a proposition is. Modal logics introduce modal operators expressing whether a proposition is necessary or possible. Temporal logics deal with propositions that are qualified by time. One can view temporal logics as a form of modal logics where propositions are qualified by time constraints. Interval temporal logic provides a way to reason about time intervals in which propositions are true.

The module will also investigate the application of logic frameworks to specific classes of problems. For example, a special subset of predicate logic, based on so-called Horn clauses, forms the basis of

logic programming languages such as Prolog. Description logics, which are usually decidable logics, are used to model relationships and they have applications in the semantic web, which enables search engines to reason about resources present on the Internet.

This 2.5 CP module supports Academic Excellence by providing essential contextual knowledge that underpins the program's qualification aims, while appropriately limiting academic depth relative to the core technical competencies of the field

Intended Learning Outcomes

No	Competence	ILO
1	Apply	Apply the various principles of logic.
2	Explain	Explain practical relevance of non-standard logic.
3	Describe	Describe how many-valued logic extends basic predicate logic.
4	Apply	Apply basic rules of fuzzy logic to calculate partial truth values.
5	Sketch	Sketch basic rules of temporal logic.
6	Implement	Implement predicates in a logic programming language.
7	Prove	Prove some simple non-standard logic theorems.

Indicative Literature

- Baader, Franz. "The Description Logic Handbook: Theory Implementation and Applications", Cambridge University Press, 2nd edition, May 2010.
- Bergmann, Merry. "An Introduction to Many-Valued and Fuzzy Logic: Semantics, Algebras, and Derivation Systems", Cambridge University Press, April 2008.
- Fisher, Michael. "An Introduction to Practical Formal Methods Using Temporal Logic", Wiley, Juli 2011.
- Sterling, Leon S., Ehud Y. Shapiro, Ehud Y. "The Art of Prolog", 2nd edition, MIT Press, March 1994.

Entry Requirements

Prerequisites	None
Co-requisites	None
Additional Remarks	None

Assessment and Completion

Module Component	Examination Type	Duration or Length	Weight (%)	Minimum for Pass	ILOs
Logic (perspective II)	Written Examination	60 Minutes	100	45%	All

Module Completion Requirements

- **Module Examination:** minimum for pass- 45%.

Module Achievement

None.

6.2.3 Causation and Correlation (perspective I)

Module Name	Causation and Correlation (perspective I)
Module Code	CTNS-NSK-03
Module ECTS	2.5
Program Owner	CT (CONSTRUCTOR Track Area)
Module Coordinator	Dr. Marina Christodoulou

Study Semester		
Program	**Semester**	**Status**
BCCB-BSc Biochemistry and Cell Biology	4	Mandatory Elective
CBT-BSc Chemistry and Biotechnology	4	Mandatory Elective
CS-BSc Computer Science	4	Mandatory Elective
ECE-BSc Electrical and Computer Engineering	4	Mandatory Elective
ESSMER-BSc Earth Sciences and Sustainable Management of Environmental Resources	4	Mandatory Elective
F-ACS-BSc Applied Computer Science	4	Mandatory Elective
GEM-BA Global Economics and Management	4	Mandatory Elective
IBA-BA International Business Administration	4	Mandatory Elective
IBA-Online-BA International Business Administration (Online)	4	Mandatory Elective
IEM-BSc Industrial Engineering & Management	4	Mandatory Elective
IEM-Online-BSc Industrial Engineering & Management (Online)	4	Mandatory Elective
IRPH-BA International Relations: Politics and History	4	Mandatory Elective
ISCP-BA Integrated Social and Cognitive Psychology	4	Mandatory Elective
MCCB-BSc Medicinal Chemistry and Chemical Biology	4	Mandatory Elective
MDDA-BSc Management, Decisions and Data Analytics	4	Mandatory Elective
MMDA-BSc Mathematics, Modeling, and Data Analytics	4	Mandatory Elective
PHDS-BSc Physics and Data Science	4	Mandatory Elective

RIS-BSc Robotics and Intelligent Systems	4	Mandatory Elective
SDT-BSc Software, Data and Technology	4	Mandatory Elective

Student Workload	
Tutorial	17.5
Independent Study	27.5
Online Lecture	17.5
Total Hours	**62.5**

Module Components	**Number**	**Type**	**CP**
Causation and Correlation	CTNS-03	Lecture (Online)	2.5

Module Description

In many ways, life is a journey. And also, as in other journeys, our success or failure depends not only on our personal traits and character, our physical and mental health, but also on the accuracy of our map. We need to know what the world we are navigating is actually like, the how, why and the what of what makes it work the way it does. The natural sciences provide the most important tool we have developed to learn how the world works and why it works the way it does. The social sciences provide the most advanced tools we have to learn how we and other human beings, similar in most ways, different in many others, act and react and what makes them do what they do. In order for our maps to be useful, they must be accurate and correctly reflect the way the natural and social worlds work and why they work as they do.

The natural sciences and social sciences are blessed with enormous amounts of data. In this way, history and the present are gifts to us. To understand how and why the world works the way it does requires that we are able to offer an explanation of it. The data supports a number of possible explanations of it. How are we to choose among potential explanations? Explanations, if sound, will enable us to make reliable predictions about what the future will be like, and also to identify many possibilities that may unfold in the future. But there are differences not just in the degree of confidence we have in our predictions, but in whether some of them are necessary future states or whether all of them are merely possibilities? Thus, there are three related activities at the core of scientific inquiry: understanding where we are now and how we got here (historical); knowing what to expect going forward (prediction); and exploring how we can change the paths we are on (creativity).

At the heart of these activities are certain fundamental concepts, all of which are related to the scientific quest to uncover immutable and unchanging laws of nature. Laws of nature are thought to reflect a causal nexus between a previous event and a future one. There are also true statements that reflect universal or nearly universal connections between events past and present that are not laws of nature because the relationship they express is that of a correlation between events. A working thermostat accurately allows us to determine or even to predict the temperature in the room in which it is located, but it does not explain why the room has the temperature it has. What then is the core difference between causal relationships and correlations? At the same time, we all recognize that given where we are now there are many possible futures for each of us, and even had our lives gone

just the slightest bit differently than they have, our present state could well have been very different than it is. The relationship between possible pathways between events that have not materialized but could have is expressed through the idea of counterfactual.

Creating accurate roadmaps, forming expectations we can rely on, making the world a more verdant and attractive place requires us to understand the concepts of causation, correlation, counterfactual explanation, prediction, necessity, possibility, law of nature and universal generalization. This course is designed precisely to provide the conceptual tools and intellectual skills to implement those concepts in our future readings and research and ultimately in our experimental investigations, and to employ those tools in various disciplines.

This 2.5 CP module supports Academic Excellence by providing essential contextual knowledge that underpins the program's qualification aims, while appropriately limiting academic depth relative to the core technical competencies of the field

Intended Learning Outcomes

No	Competence	ILO
1	Formulate	Formulate testable hypotheses that are designed to reveal causal connections and those designed to reveal interesting, important and useful correlations.
2	Distinguish	Distinguish scientifically interesting correlations from unimportant ones.
3	Apply	Apply critical thinking skills to evaluate information.
4	Understand	Understand when and why inquiry into unrealized possibility is important and relevant.

Indicative Literature

- Goodman, Nelson. Fact, fiction, and forecast. Harvard University Press, 1983.
- Quine Willard, Van Orman, and Joseph Silbert Ullian. The web of belief. Vol 2. New York: Random house, 1978.
- Thomas S. Kuhn: The Structure of Scientific Revolutions. Nelson, fourth edition, 2012.

Entry Requirements

Prerequisites	None
Co-requisites	None
Additional Remarks	None

Assessment and Completion

Module Component	Examination Type	Duration or Length	Weight (%)	Minimum for Pass	ILOs

Causation and Correlation	Written Examination	60 Minutes	100	45%	1-4

Module Completion Requirements

- **Module Examination:** minimum for pass- 45%.

Module Achievement

None.

6.2.4 Causation and Correlation (perspective II)

Module Name	Causation and Correlation (perspective II)
Module Code	CTNS-NSK-04
Module ECTS	2.5
Program Owner	CT (CONSTRUCTOR Track Area)
Module Coordinator	Dr. Eoin Ryan Dr. Irina Chiaburu Prof. Dr. Keivan Mallahi Karai

Study Semester		
Program	**Semester**	**Status**
ISCP-BA Integrated Social and Cognitive Psychology	3	Mandatory Elective
S-ACS-BSc Applied Computer Science	3	Mandatory Elective
BCCB-BSc Biochemistry and Cell Biology	4	Mandatory Elective
CBT-BSc Chemistry and Biotechnology	4	Mandatory Elective
CS-BSc Computer Science	4	Mandatory Elective
ECE-BSc Electrical and Computer Engineering	4	Mandatory Elective
ESSMER-BSc Earth Sciences and Sustainable Management of Environmental Resources	4	Mandatory Elective
F-ACS-BSc Applied Computer Science	4	Mandatory Elective
GEM-BA Global Economics and Management	4	Mandatory Elective
IBA-BA International Business Administration	4	Mandatory Elective
IBA-Online-BA International Business Administration (Online)	4	Mandatory Elective
IEM-BSc Industrial Engineering & Management	4	Mandatory Elective
IEM-Online-BSc Industrial Engineering & Management (Online)	4	Mandatory Elective
IRPH-BA International Relations: Politics and History	4	Mandatory Elective
ISCP-BA Integrated Social and Cognitive Psychology	4	Mandatory Elective
MCCB-BSc Medicinal Chemistry and Chemical Biology	4	Mandatory Elective

MDDA-BSc Management, Decisions and Data Analytics	4	Mandatory Elective
MMDA-BSc Mathematics, Modeling, and Data Analytics	4	Mandatory Elective
PHDS-BSc Physics and Data Science	4	Mandatory Elective
RIS-BSc Robotics and Intelligent Systems	4	Mandatory Elective
SDT-BSc Software, Data and Technology	4	Mandatory Elective
MMDA-BSc Mathematics, Modeling, and Data Analytics	5	Mandatory Elective

Student Workload	
Independent Study	45
Online Lecture	17.5
Total Hours	**62.5**

Module Components	**Number**	**Type**	**CP**
Causation and Correlation (perspective II)	CTNS-04	Lecture (Online)	2.5

Module Description

Causality or causation is a surprisingly difficult concept to understand. David Hume famously noted that causality is a concept that our science and philosophy cannot do without, but it is equally a concept that our science and philosophy cannot describe. Since Hume, the problem of cause has not gone away, and sometimes seems to get even worse (e.g., quantum mechanics confusing previous notions of causality). Yet, ways of doing science that lessen our need to explicitly use causality have become very effective (e.g., huge developments in statistics). Nevertheless, it still seems that the concept of causality is at the core of explaining how the world works, across fields as diverse as physics, medicine, logistics, the law, sociology, and history - and ordinary daily life - through all of which, explanations and predictions in terms of cause and effect remain intuitively central.

Causality remains a thorny problem but, in recent decades, significant progress has occurred, particularly in work by or inspired by Judea Pearl. This work incorporates many 20th century developments, including statistical methods - but with a reemphasis on finding the why, or the cause, behind statistical correlations -, progress in understanding the logic, semantics and metaphysics of conditionals and counterfactuals, developments based on insights from the likes of philosopher Hans Reichenbach or biological statistician Sewall Wright into causal precedence and path analysis, and much more. The result is a new toolkit to identify causes and build causal explanations. Yet even as we get better at identifying causes, this raises new (or old) questions about causality, including metaphysical questions about the nature of causes (and effects, events, objects, etc), but also questions about what we really use causality for (understanding the world as it is or just to glean predictive control of specific outcomes), about how causality is used differently in different fields and

activities (is cause in physics the same as that in history?), and about how other crucial concepts relate to our concept of cause (space and time seem to be related to causality, but so do concepts of legal and moral responsibility).

This course will introduce students to the mathematical formalism derived from Pearl's work, based on directed acyclic graphs and probability theory. Building upon previous work by Reichenbach and Wright, Pearl defines a "a calculus of interventions" of "do-calculus" for talking about interventions and their relation to causation and counterfactuals. This model has been applied in various areas ranging from econometrics to statistics, where acquiring knowledge about causality is of great importance.

At the same time, the course will not forget some of the metaphysical and epistemological issues around cause, so that students can better critically evaluate putative causal explanations in their full context. Abstractly, such issues involve some of the same philosophical questions Hume already asked, but more practically, it is important to see how metaphysical and epistemological debates surrounding the notion of cause affect scientific practice, and equally if not more importantly, how scientific practice pushes the limits of theory. This course will look at various ways in which empirical data can be transformed into explanations and theories, including the variance approach to causality (characteristic of the positivistic quantitative paradigm), and the process theory of causality (associated with qualitative methodology). Examples and case studies will be relevant for students of the social sciences but also students of the natural/physical world as well.

This 2.5 CP module supports Academic Excellence by providing essential contextual knowledge that underpins the program’s qualification aims, while appropriately limiting academic depth relative to the core technical competencies of the field

Recommended Knowledge

Basic probability theory

Intended Learning Outcomes

No	Competence	ILO
1	Have	Have a clear understanding of the history of causal thinking.
2	Form	Form a critical understanding of the key debates and controversies surrounding the idea of causality.
3	Recognize	Recognize and apply probabilistic causal models.
4	Explain	Explain how understanding of causality differs among different disciplines.
5	Demonstrate	Demonstrate how theoretical thinking about causality has shaped scientific practices.

Indicative Literature

- Ilari, Phyllis McKay and Federica Russo. Causality: Philosophical Theory Meets Scientific Practice. Oxford University Press 2014.
- Paul, L. A. and Ned Hall. Causation: A User’s Guide. Oxford University Press 2013.

- Pearl, Judea, Glymour Madelyn and Jewell, Nicolas. Causal Inference in Statistics: A Primer. Wiley 2016.
- Pearl, Judea. Causality: Models, Reasoning and Inference. Cambridge University Press 2009.

Entry Requirements

Prerequisites	None
Co-requisites	None
Additional Remarks	None

Assessment and Completion

Module Component	Examination Type	Duration or Length	Weight (%)	Minimum for Pass	ILOs
Causation and Correlation (perspective II)	Written Examination	60 Minutes	100	45%	1-5

Module Completion Requirements

- **Module Examination:** minimum for pass- 45%.

Module Achievement

None.

6.3 Languages

The descriptions of the language modules are provided in a separate document, the "Language Module Handbook" that can be accessed from the Constructor University's Language & Community Center internet sites (https://constructor.university/student-life/language-community-center/learning-languages).

6.4 Humanities Modules

6.4.1 Introduction to Philosophical Ethics

Module Name	Introduction to Philosophical Ethics
Module Code	CTHU-HUM-001
Module ECTS	2.5
Program Owner	CT (CONSTRUCTOR Track Area)
Module Coordinator	Dr. Eoin Ryan

Study Semester		
Program	**Semester**	**Status**
BCCB-BSc Biochemistry and Cell Biology	1	Mandatory Elective
CBT-BSc Chemistry and Biotechnology	1	Mandatory Elective
CS-BSc Computer Science	1	Mandatory Elective
ECE-BSc Electrical and Computer Engineering	1	Mandatory Elective
ESSMER-BSc Earth Sciences and Sustainable Management of Environmental Resources	1	Mandatory Elective
IBA-BA International Business Administration	1	Mandatory Elective
IBA-Online-BA International Business Administration (Online)	1	Mandatory Elective
IEM-BSc Industrial Engineering & Management	1	Mandatory Elective
IEM-Online-BSc Industrial Engineering & Management (Online)	1	Mandatory Elective
IRPH-BA International Relations: Politics and History	1	Mandatory Elective
ISCP-BA Integrated Social and Cognitive Psychology	1	Mandatory Elective

MCCB-BSc Medicinal Chemistry and Chemical Biology	1	Mandatory Elective
MDDA-BSc Management, Decisions and Data Analytics	1	Mandatory Elective
MMDA-BSc Mathematics, Modeling, and Data Analytics	1	Mandatory Elective
PHDS-BSc Physics and Data Science	1	Mandatory Elective
RIS-BSc Robotics and Intelligent Systems	1	Mandatory Elective
SDT-BSc Software, Data and Technology	1	Mandatory Elective
BCCB-BSc Biochemistry and Cell Biology	2	Mandatory Elective
CBT-BSc Chemistry and Biotechnology	2	Mandatory Elective
CS-BSc Computer Science	2	Mandatory Elective
ECE-BSc Electrical and Computer Engineering	2	Mandatory Elective
ESSMER-BSc Earth Sciences and Sustainable Management of Environmental Resources	2	Mandatory Elective
GEM-BA Global Economics and Management	2	Mandatory Elective
IBA-BA International Business Administration	2	Mandatory Elective
IBA-Online-BA International Business Administration (Online)	2	Mandatory Elective
IEM-Online-BSc Industrial Engineering & Management (Online)	2	Mandatory Elective
IRPH-BA International Relations: Politics and History	2	Mandatory Elective
ISCP-BA Integrated Social and Cognitive Psychology	2	Mandatory Elective
MCCB-BSc Medicinal Chemistry and Chemical Biology	2	Mandatory Elective
MDDA-BSc Management, Decisions and Data Analytics	2	Mandatory Elective
MMDA-BSc Mathematics, Modeling, and Data Analytics	2	Mandatory Elective
PHDS-BSc Physics and Data Science	2	Mandatory Elective
RIS-BSc Robotics and Intelligent Systems	2	Mandatory Elective

SDT-BSc Software, Data and Technology	2	Mandatory Elective

Student Workload	
Independent Study	45
Online Lecture	17.5
Total Hours	**62.5**

Module Components	**Number**	**Type**	**CP**
Introduction to Philosophical Ethics	CTHU-001	Lecture (Online)	2.5

Module Description

The nature of morality - how to lead a life that is good for yourself, and how to be good towards others - has been a central debate in philosophy since the time of Socrates, and it is a topic that continues to be vigorously discussed. This course will introduce students to some of the key aspects of philosophical ethics, including leading normative theories of ethics (e.g. consequentialism or utilitarianism, deontology, virtue ethics, natural law ethics, egoism) as well as some important questions from metaethics (are useful and generalizable ethical claims even possible; what do ethical speech and ethical judgements actually do or explain) and moral psychology (how do abstract ethical principles do when realized by human psychologies). The course will describe ideas that are key factors in ethics (free will, happiness, responsibility, good, evil, religion, rights) and indicate various routes to progress in understanding ethics, as well as some of their difficulties.

This 2.5 CP module is part of a portfolio of several 2.5 CP modules designed to allow students to have a wider choice of electives. To compensate for the smaller size of this module, the assessment is of smaller scope.

Intended Learning Outcomes

No	**Competence**	**ILO**
1	Describe	Describe normative ethical theories such as consequentialism, deontology and virtue ethics.
2	Discuss	Discuss some metaethical concerns.
3	Analyze	Analyze ethical language.
4	Highlight	Highlight complexities and contradictions in typical ethical commitments.
5	Indicate	Indicate common parameters for ethical discussions at individual and social levels.
6	Analyze	Analyze notions such as objectivity, subjectivity, universality, pluralism, value.

Indicative Literature

- Mark van Roojen Metaethicas: A Contemporary Introduction (2015).
- Russ Shafer-Landay A Concise Introduction to Ethics (2019).
- Simon Blackburn Being Good (2009).

Entry Requirements

Prerequisites	None
Co-requisites	None
Additional Remarks	None

Assessment and Completion

Module Component	Examination Type	Duration or Length	Weight (%)	Minimum for Pass	ILOs
Introduction to Philosophical Ethics	Written Examination	60 Minutes	100	45%	1-6

Module Completion Requirements

- **Module Examination:** pass/fail grading.

Module Achievement

None.

6.4.2 Introduction to Visual Culture

Module Name	Introduction to Visual Culture
Module Code	CTHU-HUM-003
Module ECTS	2.5
Program Owner	CT (CONSTRUCTOR Track Area)
Module Coordinator	Dr. Irina Chiaburu

Study Semester		
Program	**Semester**	**Status**
BCCB-BSc Biochemistry and Cell Biology	1	Mandatory Elective
CBT-BSc Chemistry and Biotechnology	1	Mandatory Elective
CS-BSc Computer Science	1	Mandatory Elective
ECE-BSc Electrical and Computer Engineering	1	Mandatory Elective
ESSMER-BSc Earth Sciences and Sustainable Management of Environmental Resources	1	Mandatory Elective
IBA-BA International Business Administration	1	Mandatory Elective
IEM-Online-BSc Industrial Engineering & Management (Online)	1	Mandatory Elective
IRPH-BA International Relations: Politics and History	1	Mandatory Elective
ISCP-BA Integrated Social and Cognitive Psychology	1	Mandatory Elective
MDDA-BSc Management, Decisions and Data Analytics	1	Mandatory Elective
MMDA-BSc Mathematics, Modeling, and Data Analytics	1	Mandatory Elective
PHDS-BSc Physics and Data Science	1	Mandatory Elective
RIS-BSc Robotics and Intelligent Systems	1	Mandatory Elective
SDT-BSc Software, Data and Technology	1	Mandatory Elective
BCCB-BSc Biochemistry and Cell Biology	2	Mandatory Elective
CBT-BSc Chemistry and Biotechnology	2	Mandatory Elective
CS-BSc Computer Science	2	Mandatory Elective

ECE-BSc Electrical and Computer Engineering	2	Mandatory Elective
ESSMER-BSc Earth Sciences and Sustainable Management of Environmental Resources	2	Mandatory Elective
GEM-BA Global Economics and Management	2	Mandatory Elective
IBA-BA International Business Administration	2	Mandatory Elective
IBA-Online-BA International Business Administration (Online)	2	Mandatory Elective
IEM-BSc Industrial Engineering & Management	2	Mandatory Elective
IEM-Online-BSc Industrial Engineering & Management (Online)	2	Mandatory Elective
IRPH-BA International Relations: Politics and History	2	Mandatory Elective
ISCP-BA Integrated Social and Cognitive Psychology	2	Mandatory Elective
MCCB-BSc Medicinal Chemistry and Chemical Biology	2	Mandatory Elective
MDDA-BSc Management, Decisions and Data Analytics	2	Mandatory Elective
MMDA-BSc Mathematics, Modeling, and Data Analytics	2	Mandatory Elective
PHDS-BSc Physics and Data Science	2	Mandatory Elective
RIS-BSc Robotics and Intelligent Systems	2	Mandatory Elective
SDT-BSc Software, Data and Technology	2	Mandatory Elective

Student Workload	
Independent Study	45
Online Lecture	17.5
Total Hours	**62.5**

Module Components	**Number**	**Type**	**CP**
Introduction to Visual Culture	CTHU-003	Lecture (Online)	2.5

Module Description

Of the five senses, the sense of sight has for a long time occupied the central position in human cultures. As John Berger has suggested this could be because we can see and recognize the world

around us before we learn how to speak. Images have been with us since the earliest days of the human history. In fact, the earliest records of human history are images found on cave walls across the world. We use images to capture abstract ideas, to catalogue and organize the world, to represent the world, to capture specific moments, to trace time and change, to tell stories, to express feelings, to better understand, to provide evidence and more. At the same time, images exert their power on us, seducing us into believing in their 'innocence', that is into forgetting that as representations they are also interpretations, i.e., a particular version of the world.

The purpose of this course is to explore multiple ways in which images and the visual in general mediate and structure human experiences and practices from more specialized discourses, e.g., scientific discourses, to more informal and personal day-to-day practices, such as self-fashioning in cyberspace. We will look at how social and historical contexts affect how we see, as well as what is visible and what is not. We will explore the centrality of the visual to the intellectual activity, from early genres of scientific drawing to visualizations of big data. We will examine whether one can speak of visual culture of protest, look at the relationship between looking and subjectivity and, most importantly, ponder the relationship between the visual and the real.

This 2.5 CP module is part of a portfolio of several 2.5 CP modules designed to allow students to have a wider choice of electives. To compensate for the smaller size of this module, the assessment is of smaller scope.

Intended Learning Outcomes

No	Competence	ILO
1	Understand	Understand a range of key concepts pertaining to visual culture, art theory and cultural analysis.
2	Understand	Understand the role visuality plays in development and maintenance of political, social, and intellectual discourses.
3	Think	Think critically about images and their contexts.
4	Reflect	Reflect critically on the connection between seeing and knowing.

Indicative Literature

- Berger, J., Blomberg, S., Fox, C., Dibb, M., & Hollis, R. (1973). Ways of seeing.
- Foucault, M. (2002). The order of things: an archaeology of the human sciences (Ser. Routledge classics). Routledge.
- Hunt, L. (2004). Politics, culture, and class in the French revolution: twentieth anniversary edition, with a new preface (Ser. Studies on the history of society and culture, 1). University of California Press.
- Miller, V. (2020). Understanding digital culture (Second). SAGE.
- Thomas, N. (1994). Colonialism's culture: anthropology, travel and government. Polity Press.

Entry Requirements

Prerequisites	None
Co-requisites	None
Additional Remarks	None

Assessment and Completion

Module Component	Examination Type	Duration or Length	Weight (%)	Minimum for Pass	ILOs
Introduction to Visual Culture	Written Examination	60 Minutes	100	45%	1-4

Module Completion Requirements

- **Module Examination:** minimum for pass- 45%.

Module Achievement

None.

6.4.3 Introduction to the Philosophy of Science

Module Name	Introduction to the Philosophy of Science
Module Code	CTHU-HUM-002
Module ECTS	2.5
Program Owner	CT (CONSTRUCTOR Track Area)
Module Coordinator	Dr. Eoin Ryan

Study Semester		
Program	**Semester**	**Status**
BCCB-BSc Biochemistry and Cell Biology	1	Mandatory Elective
CBT-BSc Chemistry and Biotechnology	1	Mandatory Elective
CS-BSc Computer Science	1	Mandatory Elective
ECE-BSc Electrical and Computer Engineering	1	Mandatory Elective
ESSMER-BSc Earth Sciences and Sustainable Management of Environmental Resources	1	Mandatory Elective
GEM-BA Global Economics and Management	1	Mandatory Elective
IBA-BA International Business Administration	1	Mandatory Elective
IBA-Online-BA International Business Administration (Online)	1	Mandatory Elective
IEM-Online-BSc Industrial Engineering & Management (Online)	1	Mandatory Elective
IRPH-BA International Relations: Politics and History	1	Mandatory Elective
ISCP-BA Integrated Social and Cognitive Psychology	1	Mandatory Elective
MCCB-BSc Medicinal Chemistry and Chemical Biology	1	Mandatory Elective
MDDA-BSc Management, Decisions and Data Analytics	1	Mandatory Elective
MMDA-BSc Mathematics, Modeling, and Data Analytics	1	Mandatory Elective
PHDS-BSc Physics and Data Science	1	Mandatory Elective
RIS-BSc Robotics and Intelligent Systems	1	Mandatory Elective
SDT-BSc Software, Data and Technology	1	Mandatory Elective

BCCB-BSc Biochemistry and Cell Biology	2	Mandatory Elective
CBT-BSc Chemistry and Biotechnology	2	Mandatory Elective
CS-BSc Computer Science	2	Mandatory Elective
ECE-BSc Electrical and Computer Engineering	2	Mandatory Elective
ESSMER-BSc Earth Sciences and Sustainable Management of Environmental Resources	2	Mandatory Elective
IBA-BA International Business Administration	2	Mandatory Elective
IBA-Online-BA International Business Administration (Online)	2	Mandatory Elective
IEM-BSc Industrial Engineering & Management	2	Mandatory Elective
IEM-Online-BSc Industrial Engineering & Management (Online)	2	Mandatory Elective
IRPH-BA International Relations: Politics and History	2	Mandatory Elective
ISCP-BA Integrated Social and Cognitive Psychology	2	Mandatory Elective
MCCB-BSc Medicinal Chemistry and Chemical Biology	2	Mandatory Elective
MDDA-BSc Management, Decisions and Data Analytics	2	Mandatory Elective
MMDA-BSc Mathematics, Modeling, and Data Analytics	2	Mandatory Elective
PHDS-BSc Physics and Data Science	2	Mandatory Elective
RIS-BSc Robotics and Intelligent Systems	2	Mandatory Elective
SDT-BSc Software, Data and Technology	2	Mandatory Elective

Student Workload	
Independent Study	45
Online Lecture	17.5
Total Hours	**62.5**

Module Components	**Number**	**Type**	**CP**
Introduction to the Philosophy of Science	CTHU-002	Lecture (Online)	2.5

Module Description

This humanities module will introduce students to some of the central ideas in philosophy of science. Topics will include distinguishing science from pseudo-science, types of inference and the problem of induction, the pros and cons of realism and anti-realism, the role of explanation, the nature of scientific change, the difference between natural and social sciences, scientism and the values of science, as well as some examples from philosophy of the special sciences (e.g., physics, biology).

The course aims to give students an understanding of how science produces knowledge, and some of the various contexts and issues which mean this process is never entirely transparent, neutral, or unproblematic. Students will gain a critical understanding of science as a human practice and technology; this will enable them both to better understand the importance and success of science, but also how to properly critique science when appropriate.

This 2.5 CP module is part of a portfolio of several 2.5 CP modules designed to allow students to have a wider choice of electives. To compensate for the smaller size of this module, the assessment is of smaller scope.

Intended Learning Outcomes

No	Competence	ILO
1	Understand	Understand key ideas from the philosophy of science.
2	Discuss	Discuss different types of inference and rational processes.
3	Describe	Describe differences between how the natural sciences, social sciences and humanities discover knowledge.
4	Identify	Identify ways in which science can be more and less value-laden.
5	Illustrate	Illustrate some important conceptual leaps in the history of science.

Indicative Literature

- James Ladyman, Understanding Philosophy of Science (2002).
- Paul Song, Philosophy of Science: Perspectives from Scientists (2022).
- Peter Godfrey-Smith Theory and Reality (2021)

Entry Requirements

Prerequisites	None
Co-requisites	None
Additional Remarks	None

Assessment and Completion

Module Component	Examination Type	Duration or Length	Weight (%)	Minimum for Pass	ILOs
Introduction to the Philosophy of Science	Written Examination	60 Minutes	100	45%	1-5

Module Completion Requirements

- **Module Examination:** minimum for pass- 45%.

Module Achievement

None.

7 Appendix

7.1 Intended Learning Outcomes Assessment-Matrix

Industrial Engineering & Management BSc					General Logistics	General IE	Intro to Int. Business	Intro to Finance & Accounting	Process Model and Simulation	Operations Research	Applied Project Management	Lean and Quality Management	Product and Pr System Design	Prod Planning & Control	AI & Data Managm. for Industrial Solutions	Int. Strategic Management	Blockchain Tech. and Apps.	Advanced Product Design	Sustainable Supply Chain Management	Integrated Decision Making in SCM	Distribution & E-commerce	Purchasing & Supply Management	Law of Transportation, For. and Log.	Machine Learning	Econometrics	Digital Marketing Fundamentals and SEO	Internship	Bachelor's Thesis	CT Methods	CT New Skills	CT Language / Humanities
Semester					1	2	1	2	3	3	3	4	3	4	4	4	6	6	6	6	6	6	6	6	6	6	5	6	1-4	3-6	1-2
Mandatory (m) / Mandatory Elective (me)					m	m	m	m	m	m	me	m	m	m	m	me	me	me	me	me	me	me	me	me	me	me	m	m	m	me	me
Credits					7.5	7.5	7.5	7.5	5	5	7.5	5	5	5	5	7.5	5	5	2.5	2.5	2.5	2.5	2.5	5	5	5	30	15	20	20	5
	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	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	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	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	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				
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							
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		
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 application		x	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	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			
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	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		x	x	x
Assessment Type																															
Written examination					x	x	x	x		x		x	x	x									x	x	x				x	x	x
Term paper																	x					x									
Essay																															x
Project report																											x				
Poster presentation																											x				
Laboratory report																															
Program code																															
Oral examination																															x
Presentation											x															x		x		x	x
Practical Assessment																															
Project assessment					x	x			x				x		x			x	x	x	x										
Portfolio Assessment																x															
Bachelor Thesis																												x			
Module achievements							x																						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