Master of Science in Engineering - Sustainable Product Creation

Semestre 1

	CM (UE)	TD (UE)	ECTS
Project management			4
Project management	56		4
Sensors & signal processing			3
Sensors & signal processing	30	15	3
Matlab Programming for engineers			3
Matlab Programming for engineers	60		3
Life Cycle Assessment and Eco Design			3
Life Cycle Assessment and Eco Design	45		3
Supply Chain and Logistics			4
Supply Chain and Logistics	52		4
Assessment of Finite Element Calculations			3
Assessment of Finite Element Calculations (optionnel)	30	6	3
CAD & CAE			4
CAD & CAE (optionnel)	56		4
Machine design			4
Machine design (optionnel)	56		4
Production technologies and Industrial Management			5
Production technologies and Industrial Management (optionnel)	75		5
Networking			3
Networking (optionnel)	30		3
Technical Systems Modeling and Simulation			4
Technical Systems Modeling and Simulation (optionnel)	30	15	4

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	CM (UE)	TD (UE)	ECTS
Communication Theory			3
Communication Theory (optionnel)	30		3

Semestre 2

	CM (UE)	TD (UE)	ECTS
Product Planning & Marketing for Engineers			3
Product Planning & Marketing for Engineers	45		3
Managerial Accounting			3
Managerial Accounting	36		3
Assembly and testing technologies			3
Assembly and testing technologies - old	45		3
Assembly and testing technologies	45		4
Programming for engineers			3
Programming for engineers - old	45		3
Programming for engineers	45		4
Digital Factory Planning			3
Digital Factory Planning	0		3
Robotics			4
Robotics	0		4
Structural Dynamics			4
Structural Dynamics (optionnel)	40		4
Advanced engineering materials			4
Advanced engineering materials (optionnel)	45		4

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	CM (UE)	TD (UE)	ECTS
Machine Design Exercise			3
Machine Design Exercise (optionnel)	45		3
Advanced Control			3
Advanced Control (optionnel)	24		3
Networked Feedback Systems			5
Networked Feedback Systems (optionnel)	30	15	5
Advanced Robotics Class 2			0
Advanced Robotics Class 2 (optionnel)	120		4
Quality of service in computer networks			5
Quality of Service in Computer Networks (optionnel)	45		5
Information theory and coding			5
Information Theory and Coding (optionnel)	45		5

Semestre 3

	CM (UE)	TD (UE)	ECTS
Advanced Project / Case Study			12
Advanced Project / Case Study	180		12
Lean Six Sigma - Green Belt			3
Lean Six Sigma - Green Belt	45		3
Operational excellence			2
Operational excellence	20		2
Scientific writing and presentation skills			3
Scientific writing and presentation skills	58		3
Artificial Intelligence : The course includes the following topics: 1.General introduction to Aritificial Intelligence 2.Problem resolution, search algorithms, 3.Games, alpha-beta pruning 4.Meta-heuristics, genetic algorithms, swarm algorithms 5.Constraint programming 6.Markov Decision			5

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	CM (UE)	TD (UE)	ECTS
Processes, reinforcement learning 7.Learning models for regression, classification, clustering 8.Evaluating the performance of a learning model 9.Decision trees, forests 10.Artificial neural networks 11.Unsupervised learning, k-Nearest neighbours, self-organising maps, growing neural gas			
Artificial Intelligence (optionnel)	0	0	5
Electrical Energy Production Transportation and Distribution			3
Electrical Energy Production Transportation and Distribution (optionnel)	30		3
Energetics of the blast furnace			3
Energetics of the blast furnace (optionnel)	30		3

Semestre 4

	CM (UE)	TD (UE)	ECTS
Master thesis			30
Master thesis	600		30

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Semestre 1

Project management

Module: Project management (Semestre 1)

ECTS: 4

Langue: Anglais

Obligatoire: Oui

Evaluation: As the learning happens during the workshop, the attendance to all the days is mandatory to be accepted to the exam.

Written examination

Professeur: GANTENBERG Martin Dirk

Sensors & signal processing

Module: Sensors & signal processing (Semestre 1)

ECTS: 3

Langue: Anglais

Obligatoire: Oui

Matlab Programming for engineers

Module: Matlab Programming for engineers (Semestre 1)

ECTS: 3

Objectif: This course introduces basic methods, algorithms and programming techniques to solve mathematical problems. The course is designed for students to learn how to develop numerical methods and estimate numerical errors using basic calculus concepts and results, as well as writing programs to implement the numerical methods with the Matlab software package.

Course learning outcomes: Having successfully completed the module, students will be able to demonstrate knowledge and understanding of:

1. Numerical methods to solve systems of linear equations;

2. Numerical methods to compute quadratures;
3. Numerical methods to solve ordinary differential equations;
4. Numerical methods to solve simple partial differential equations;
5. Write Matlab programs, to solve the above problems.

Description:

1. Nonlinear equations
2. Linear systems

a. Matrix equations

b. Eigenvalue problem

3. Curve fitting and interpolation
4. Numerical differentiation
5. Numerical Integration
6. Ordinary Differential Equations

a. Initial value problem

b. Boundary value problem

7. Partial Differential Equations (PDEs)

a. Basic theory, simple PDEs (Poisson, Heat, Wave).

b. Numerical solutions of PDEs.

8. Matlab a. Introduction, commands to solve integration problems and ordinary and partial differential equations.

Basic programming techniques.

Modalité d'enseignement: Lecture

Langue: Anglais

Obligatoire: Oui

Evaluation: Homework, Presentation, and Exam.

Professeur: HICHRI Bassem

Life Cycle Assessment and Eco Design

Module:	Life Cycle Assessment and Eco Design (Semestre 1)
ECTS:	3
Objectif:	Students of this course learn to design products/megastructures following the principles of sustainability. For that, students get to know what sustainable products and sustainable resources can mean. Additionally, students understand how a product's performance for sustainability can be assessed in order to critically reflect on it. Particularly, the course aims at enabling students to apply life cycle assessment (LCA) and eco-design methods.
Course learning outcomes:	After successfully participating in the course, students will be able to 1.) independently improve the environmental performance of their products/megastructures and developing sustainable product concepts by applying eco-design strategies, principles and methods in the early stages of the development process, 2.) integrate the ecological perspective in the technical product creation, 3.) critically analyze LCA studies, and 4.) conduct their own LCA studies.
Description:	The course includes a mix of lecture, individual and group work exercises, discussions and feedback sessions. Students work on one assignment and present it in the course. In addition to the final examination, this assignment contributes to the rating of students. The content of the course focusses on the following main areas: - Introduction to sustainable development and related concepts such as circular economy and planetary boundaries. - The importance of life cycle thinking/management for engineers from a business perspective in the context of sustainable development - The life cycle of products and megastructures - Environmental impacts of products and megastructures and their indicators - Examples of eco-designed products - Eco-design strategies, principles and methods - Limitations of eco-design - The importance of LCA - (Manual) calculation of LCA

- Software tools

- Practical issues of LCA

- Critical review of LCA studies (assignment)

- Extensions of LCA through planetary boundaries and Life Cycle Benefit Analysis

- LCA and eco-design in early stages of the development process

Modalité d'enseignement: Lecture

Langue: Anglais

Obligatoire: Oui

Evaluation: Written Examination

Remarque: Baumann, H; Tillman, A-M: The Hitch Hiker's Guide to LCA: An Orientation in Life Cycle Assessment Methodology and Applications. Professional Pub. Service 2004

Vogtländer, J: LCA-based assessment of sustainability: the Eco-costs/Value Ratio EVR. Delft Academic Press DAP 2010

Jonker, G; Harmsen, J: Engineering for Sustainability: A Practical Guide for Sustainable Design. Elsevier 2012

Crul, M.R.M; Diehl J.C: Design for Sustainability: A Step-by-Step Approach. United Nations Environment Programme 2009

Vezzoli, C; Manzini E: Design for Environmental Sustainability. Springer 2008

Professeur: WALTERSDORFER Gregor

Supply Chain and Logistics

Module: Supply Chain and Logistics (Semestre 1)

ECTS: 4

Objectif:

- Provide knowledge and insight into supply chain systems as a whole (manufacturing, distribution, retail and customer demand)
- Identify the critical infrastructure for production and distribution
- Understand uncertainty and decision making issues in logistics and supply chain management (eg. make-or-buy, competition, collaboration strategies)
- Understand the effect of different management policies (information, control, contracting, outsourcing etc.)
- Provide conceptual, analytical and numerical tools for modeling and solving logistics and supply chain applications
- Understand the concept of closed-loop supply chain systems and reverse logistics and their impact on sustainability

- Give insight into network economics and system dynamics in supply chains.

Course learning outcomes:

1. Provide the student with a basic knowledge of logistics and supply chain systems, what are the relations between the different players, and how these systems work from supplier to customers.
2. Learn how to manage complex networks and how to organize efficient and sustainable distribution logistics in order to maximize the overall profit and sustainability in the system.

Description:

- SCM introduction & strategic fit
- Logistics system dynamics incl. simulation "Beergame"
- Supply chain coordination and integration
- Supply chain network design, transport and distribution
- Forecasting & Sales and Operations Planning
- Capacity/inventory management & MRP
- SCM contracting for performance
- Sustainability, closed-loop supply chains and reverse logistics
- Procurement process & strategy
- Outsourcing/Risk Management and Supplier Development
- Innovations in Logistics and SCM
- Case studies
- Exercises as homework

Themes:

1. The complexity of modelling supply chain and logistics networks is elaborated in detail, from the production phase to final delivery to markets and customers and how they get to equilibrium; emphasis is given to the costs, large savings and environmental improvements that can be obtained with efficient supply chain management and when integrating the product creation and movement along the chain.
2. Different management solutions are described in the second part of the course to learn how to reduce distribution logistics costs, limit supply chain dynamics, improve sustainability and finally maximize profits.

Langue: Anglais

Obligatoire: Oui

Evaluation: Written examination, 90min

Remarque: Literature:

- Chopra, S, Meindl, P. (2016): Supply Chain Management: Strategy, Planning, and Operation, 6th ed., Upper Saddle NJ, Pearson, Boston, 2016
- Christopher, M. (2016): Logistics & Supply Chain Management, 5th edition, Harlow, Prentice Hall, 2016
- Jacobs, F. R., Chase, R. B. (2018): Operations and Supply Chain Management, 15th Global Edition, McGraw-Hill Education, New York, 2018
- Simchi-Levi, D., Kaminsky, P., Simchi-Levi, E. (2008): Designing and managing the supply chain, 3 rdedition, McGraw Hill, New York, 2008
- Van Weele, A. (2018): Purchasing and Supply Management, 7 thedition, Cengage Learning EMEA, Andover, UK, 2018

Articles from literature/ hand-outs

Professeur: KORNE Thomas Bert

Assessment of Finite Element Calculations

Module:	Assessment of Finite Element Calculations (Semestre 1)
ECTS:	3
Course learning outcomes:	On completion of the course unit successful students will be able to: The student is enabled to use and understand a well-established norm [1] for analytical strength assessment of components based on local stresses calculated with the help of the finite element method. As this norm is well known in industry and research (6 thedition), its use and the respective background are detailed in this lecture. The student understands why the norm imposes a specific procedure for static and a different one for fatigue assessment and what the relevant influence factors are. All important background information is given by two classical textbooks [2], [4], multiple handouts and three discussed examples. The additional information deploys the relevant physical background phenomena quantitatively, where the norm is short. Vice-versa, the textbooks etc. do not contain numerical quantity values for direct use, what the only norm does.
Description:	Lecture 1: Introduction to the problem (General survey of FKM, Chapt. 0, [1]) and by discussion of an analytical example: stress distribution in a thick walled pressurized tube. Repetition of principle stresses and three stress hypotheses for combined stress. Difference between Fatigue Assessment and Fracture Mechanics (1.handout 7 pages, fracture mechanics not part of this lecture), definition of local and nominal stresses (assessment by use of nominal stresses is not part of this lecture). Lecture 2: Definition of local, uniaxial, multiaxial, proportional, synchronous and non-proportional stresses. Procedure of calculation and demarcation with respect to nominal stresses, repetition of basics: effect of notches, stress concentration factor SCF or Kt Lecture 3: Chapt. 3.0 – 3.1.2.2 of FKM [1]: combined stress in case of brittle and ductile material, multiaxiality, repetition of basics: stress-strain curve, simplification of elastic-ideal plastic behavior, hardening, real stress and real strain, yield-curve of a component, (2.handout 1 page, reinforced concrete), section factor, stress and strain distribution of a smooth specimen subject to bending, NEUBER equation with example (3.handout 1 page), plastic strain limits vs. elongation at break, plastic limit loading. Lecture 4: Chapt. 3.1.2.2 – 3.2.1.2 of FKM [1] : effect of thickness and repetition of basics: plain stress sate and plain strain state, full plasticity and collapse loading, effect of pre- or residual-stress for brittle and ductile material, loading and unloading, reverse-plastification, (4.handout 1 page, effect of post-weld-heat-treatment) Lecture 5: Chapt. 3.2.1.2 – 3.6.1.2 of FKM [1]: effect of thickness, elevated temperature including creep (5. handout 2 pages), section factor n plof FKM based on NEUBER rule, plastic notch factor and strain limit, typical safety factors and assessment incl. multiaxiality; definition of stress categories: primary & secondary, membrane, bending & peak stresses only to demark from ASME-code approach (not part of the lecture), repetition of basics: failure load of brittle and ductile material, Charpy-impact testing.

Lecture 6: Chapt. 4.0 – 4.1.3.1 of FKM [1] : s-n-line, stress ratio R, stress spectrum, endurance limit, slope k, and repetition of basics: cyclic loading, proportional, synchronous and non-proportional loading, finite life and endurance limit, stress-range R and the s-n-line (Wöhlerline), 'slope' of the s-n-line, knee point, typical scatter T nand T svalues, statistics of cyclic testing and normalized s-n-line

Lecture 7: Chapt. 4.1.3.1 – 4.1.3.2 of FKM [1] : constant amplitude s-n-curve, mean stress influence, and repetition of basics: alternating and pulsating loading, endurance strength limits for different materials and loadings, effect of mean stress- Haigh and Smith diagram, mean stress sensitivity, simplified Haigh diagram acc. to FKM, static limits of the Haigh-diagram, effect of surface, size, stress gradient (or volume) and corrosive environment on the endurance limit, effect of notches, definition of fatigue notch factor Kf vs. form factor Kt (=SCF), dynamic support factor= Kt - Kf-ratio

Lecture 8: Chapt. 4.1.3 – 4.6.2.2 of FKM [1]: influence of mean stress and variable amplitude, fatigue limit=endurance limit, temperature influence, 6. handout 1 pages to repeat support factor= Kt - Kf-ratio, related stress gradient, design factor KWK, mean stress factor KAK, variable amplitude fatigue strength factor KBK, the different fields of the HAIGH diagram, two simplified models of s-n-lines, Miner´s elementary and consistent rule, damage sum, degree of utilisation, stress spectrum and its determination by rainflow- and rainfill=reservoir-counting (example with 7. handout -5 pages)

Lecture 9: First full example, based on our open access-peer-reviewed publication [3] (8 . handout - 7 pages)

Lecture 10: Chapt. 6.0 – 6.2.2 of FKM [1]: Discussion of two fully detailed examples in the annexe of FKM

Lecture 11: ANSYS-Workbench, computer room: introduction into the software, modelling of a thick walled tube

Lecture 12: ANSYS-Workbench, computer room: 9 . handout, send by email – geometry of first example, ref. to lecture 9)

Lecture 13: ANSYS-Workbench, computer room: full linear and non-linear calculation acc. to FKM for the example of lecture 9, repetition and summary of theory (10 . handout - 7 pages)

Modalité d'enseignement: Lectures + tutorials

Langue: Anglais

Obligatoire: Non

Evaluation: Written exam

Remarque:

2. Literature / Littérature / Literatur

[1] FKM Guideline, 6th Edition 2012, Analytical Strength Assessment of Components, ISBN 978-3-8163-0649-8

[2] Fundamentals of Machine Elements, SI Version, 3rd Edition, CRC-Press, ISBN 978-1-4822-4748-0

[3] Design rules for autofrettage of an aluminum valve body; S. Sellen, S. Maas, T. Andreas, P. Plapper, A. Zürbes and D. Becker, http://onlinelibrary.wiley.com/doi/10.1111/ffe.12328/abstract

[4] Issler, Ruoss, Häfele, Festigkeitslehre – Grundlagen, Springer, ISBN 3-540-40705-7 10 handouts during the lectures (in English)

Professeur: MAAS Stefan

CAD & CAE

Module: CAD & CAE (Semestre 1)

ECTS: 4

Langue: Anglais

Obligatoire: Non

Machine design

Module: Machine design (Semestre 1)

ECTS: 4

Objectif: The aim of the course is:

· to deepen knowledge of designs of machine elements gained in the courses of machine element in bachelor study

· to present advanced design methods of mechanical parts

· to introduce advanced tools (CAE) of analyses of machine design: FEA – ANSYS/ Inventor, CAD – Inventor, reporting/ calculations – Mathcad, and Fusion 360 - CAD cloud computing

to build base student knowledge of machine design, which is needed for their projects in semester 2 - Machine Design Exercise.

Course learning outcomes: After the course, the student:

- is able to carry out a design process of mechanical objects
- uses in practice analytical equations of mechanics to design machine elements
- solves real technical problems using previously acquired knowledge of subjects: mechanics, strength of materials, machine element design, and CAD
- is able to proposean appropriate technological process of manufacture and assembly for a particular machine element
- knows how to utilise CAE tools like ANSYS, Inventor, and Mathcad in design projects

	is able to understand the concept of the machine element optimisation and employ this method in projects.
Description:	1. Part I Fundamentals o Tolerances and fits. Deviations of form and position and surface roughness o Loads, analysis, materials, static body stresses o Fatigue and impact o Safety factor, reliability 2. Part II - Machine Elements o Stresses and deformations in cylinders o Shafts and associated parts o Bearings o General gear theory § spur sears, helical, bevel and worm gears o Manual gearboxes designs o Brakes and clutches o Flexible machine elements § belts, wire ropes, rolling chains Machine element optimisation
Modalité d'enseignement:	Lecture and practical exercises
Langue:	Anglais
Obligatoire:	Non
Evaluation:	50% written exam + 50% project assignments
Remarque:	"Fundamentals of Machine Elements, Third Edition", Steven R. Schmid, Bernard J. Hamrock, Bo. O. Jacobson · Course materials available on Moodle system ? "Fundamentals of Machine Components Design " , R. C. Juvinall, Kurt M. Marshek " Mark's Calculations for Machine Design " , Thomas Brown. " Shigley's Mechanical Engineering Design", Richard G Budynas, Keith J Nisbett. " Engineering Drawing and Design", 5th Edition, David A. Madsen, David P. Madsen

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Professeur: KEDZIORA Slawomir

Production technologies and Industrial Management

Module: Production technologies and Industrial Management (Semestre 1)

ECTS: 5

Objectif: Introduce the broad range of production technologies which are used in modern manufacturing industry, comprehend the impact of manufacturing to cautious use of resources (like energy, raw materials and floor space) and realize the opportunities for sustainable use of resources through early interaction with product designers.

Course learning outcomes: The students will know all relevant manufacturing technologies and the related strength and understand weaknesses, especially in regard to sustainable use of resources.
The students will Identify, formulate, and solve manufacturing engineering issues under energetic and economic constraints.
For example to produce light weight product out of CFRP or to develop for energy saving machines with limited use of compressed air
the students will know state-of-the art manufacturing technologies to produce modern products.
They will understand opportunities of manufacturing to limit usage of energy, material and other resources.
The students will understand the impact of manufacturing on cost, quality and energy.

Description: These production technologies and their specific use of resources will be discussed:

· Primary shaping (Casting, sintering, extruding, ..)

· Forming (Massive forming and sheet metal forming,..)

· Cutting (Turning, Milling, Grinding, EDM, …)

· Coating (Painting, Anodizing, Physical Vapour deposition,..)

· Laser technology

· Additive Manufacturing

· CNC Machines and Controls

· Development of production processes and implementation of machines

· Assembly time prediction based on Methods Time Measurement · Organization of industrial production

Modalité d'enseignement: Lectures

Langue: Anglais

Obligatoire: Non

Evaluation: Written exam

Professeur: PLAPPER Peter

Networking

Module: Networking (Semestre 1)

ECTS: 3

Objectif: Introduce higher networking layers and mathematical descriptions of network concepts as Multiple Access Control (ALOHA, collision detection and resolution), Error detecting and correcting codes, ARQ, routing and flow control, Queueing and QoS.

Description:
* Hierarchical Model of Network Functions (OSI Model, Service Access Points)
* Point-to-Point Data Transmission (synchronous and asynchronous multiplexing, packets)
* Error correcting and detecting codes, ARQ protocols
* Multiple Access Control (ALOHA, Slotted ALOHA, collision resolution, detection and avoiding)
* Routing and flow control
* Introduction to Queueing Theory
* Mobile Network Access Schemes
* Quality of Service Parameters in TCP/IP

Modalité d'enseignement: The course consists of a series of lectures with dedicated time slots for exercises

Langue: Anglais

Obligatoire: Non

Evaluation: There is a final exam counting 70%.
Successful preparation, submission and participation in exercises is valued 30%

Professeur: ENGEL Thomas

Technical Systems Modeling and Simulation

Module: Technical Systems Modeling and Simulation (Semestre 1)

ECTS: 4

Objectif: In the seminar, techniques for modeling of technical systems are elaborated in case studies for typical technical systems employing symbolic and numeric computation methods.

Course learning outcomes:
* Build mathematical models for dynamics of technical systems derived from basic principles
* Use advanced tools for numeric and symbolic computing
* Apply decomposition, transformation and approximation methods
* Elaborate a case study and present computational results

Description:
1 Technical Systems
2 System Structures and Model Descriptions
3 Continuous Models from Variational Analysis

	4 Model Simplification 5 Optimal System Operation
Modalité d'enseignement:	The course consists half of introductional lectures, and half of practical work.
Langue:	Anglais
Obligatoire:	Non
Evaluation:	Final grade is composed of seminar simulation works (1/3) and final presentation (2/3).
Remarque:	**Literature:** Kondipudi, Prigogine : Modern Thermodynamics, Wiley&Son, 1998 Baumann : Symmetry Analysis of Differential Equations, Springer Verlag, 2000 Ljung, Glad : Modelling of Technical Systems, Prentice Hall, 1995 Wellsted: Introduction to Physical Modeling, Control Systems Principles, 2000
Professeur:	TATARINOV Dimitri

Communication Theory

Module:	Communication Theory (Semestre 1)
ECTS:	3
Objectif:	Provide mathematical fundamentals of the physical layer like stochastic signals and systems, ML and MAP principle, modulation, and channel models.
Course learning outcomes:	* Describe fundamental parameters of signals, systems, and channels * Take optimal stochastic decisions based on observations
Description:	* Signals and Systems * Convolution * Sampling * Stochastic Signals and Noise * Modulation and Demodulation * The Maximum Likelihood Principle * Sources and Channels
Modalité d'enseignement:	* Review of Stochastic Signals and Systems * Digital Transmission and Modulation * Demodulation * Channel Models * ML Principle * Matched Filter * Equalization
Langue:	Anglais
Obligatoire:	Non
Evaluation:	Final Exam (100%)
Professeur:	SORGER Ulrich

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Semestre 2

Product Planning & Marketing for Engineers

Module: Product Planning & Marketing for Engineers (Semestre 2)

ECTS: 3

Objectif: The students understand the importance of market oriented product design.
They know marketing terminology and methods.
They can prepare decisions to target specific market segments.

Course learning outcomes: The students will be able to develop a compelling marketing strategy of their engineering product or service. They understand the importance of considering customer needs in the engineering design and reflect buying power of the customers.

Description:
- Basic concepts of marketing
- Market planning
- Development of marketing strategies
- Market research
- Product strategies
- Pricing
- Advertising, Sales and Marketing
- Business plan for a start-up

Case studies will enable the students to apply the learned competencies.

Langue: Anglais

Obligatoire: Oui

Evaluation: 20% presentation and class participation and 80% exam

Professeur: KÖNIG Tatjana

Managerial Accounting

Module: Managerial Accounting (Semestre 2)

ECTS: 3

Objectif: This course is an intensive introduction to the preparation and interpretation of financial information for investors (external users) and managers (internal users) and to the use of financial instruments to support system and project creation.

The course adopts a decision-maker perspective on accounting and finance with the goal of helping students develop a framework for understanding financial, managerial, and tax reports.

The course will also explore how cost-volume-profit relationships and incremental analysis provide managers the information to support their decision-making.

Course learning outcomes:

This course will enable you

· To acquire an overview of the use of accounting data by managers for financial and operational planning and control.

· To evaluate the organizational role of management accountants and describe accounting systems used by manufacturing businesses.

· To acquire a basic knowledge in the techniques and procedures of costing systems, profit planning, and the collection and use of cost data in decision making.

· To develop a basic foundation in the concepts of cost behaviour and cost systems design.

· To understand basic managerial and cost accounting concepts such as cost-volume-profit, budgeting, product costing and cost behaviour.

· To prepare, use and evaluate budgetary data.

· To evaluate capital expenditure decisions using discounted cash flow

· To analyze Capital Investment Alternatives.

· To apply and interpret basic financial statement analysis.

Modalité d'enseignement:

The course will be delivered online through a series of Webinar lectures, slide presentations, case studies, and on-going participation in discussion forums.

All lecture slides, Connect Account/Submission assignments and forum topic participation requirements will be provided on a weekly basis. Each student should consult the Moodle platform daily for announcements.

Langue: Anglais

Obligatoire: Oui

Evaluation:

Assessment will be based on Weekly Connect/Submission Assignments (10% or 12pts), Weekly Participation in Forums (10% or 12pts), Group Case Studies (10% or 12pts), a Midterm Exam (20% or 24pts), and the Final Exam (50% or 60pts).

Weekly Assignments

All weekly assignments will be communicated with a view that enough time is given for the work to be completed. Instructions on your forum participation, Connect account/submission requirements will be communicated. The Weekly Connect/Submission assignment is 20% or 24pts and the Forum Participation is also 20% or 24pts of the total assessment score.

Group Project

Case Studies in groups will be assigned. 10% or 12pts of the total assessment score.

Midterm Test

The midterm Test will be a summary review of the weekly assignments based on textbook chapters and material covered in class. The midterm exam will take place online and will be 20% or 24pts of the total assessment score.

Final Exam

The final exam will be a summary review of the weekly assignments based on textbook chapters and material covered in class. The final exam will take place on campus and will be 50% or 60pts of the total assessment score.

Attendance

Attendance is part of the forum participation mark. 80% of lecture attendance on courses is compulsory for obtaining the ECTS units related to that course and module. Attendance is recorded as meeting the forum participation rule of 2 separate posts 2 times per week.

Note: Instructor reserves the right to change the Weekly Assignments, the Group Project or Quizzes during the semester.

Remarque:

Required Tex:

Garrison, R., E. Noreen, and P. Brewer. Managerial Accounting, 2nd Edition New York: McGraw-Hill/Irwin

with Connect Account: ISBN-13 9780071221085

Indicative Reading:

Illustrative texts and articles include:

· A Bhimani, Strategic Finance, Strategy Press, (2008)
· C Horngren, A Bhimani, S Datar & G Foster, Management and Cost Accounting, FT/ Prentice Hall (2008)
· A. Bhimani, Contemporary Issues in Management Accounting, Oxford University Press (2006)
· Emsley, Redesigning variance analysis for problem solving, Management Accounting Research (2001) pp.21-40
· Davila, T. and Wouters, M. (2005) "Managing budget emphasis through the explicit design of conditional budgetary slack", Accounting, Organizations and Society: 30, 587-608
· Miller & O'Leary, Managing operational flexibility in investment decisions: the case of Intel, Journal of Applied Corporate Finance (2005), pp. 87-93.
· Hall, M. (2008). The effect of comprehensive performance measurement systems on role clarity, psychological empowerment and managerial performance. Accounting, Organizations and Society, 33(2-3), 141-163.

Professeur: LOPATTA Kerstin

Assembly and testing technologies - old

Module: Assembly and testing technologies (Semestre 2)

ECTS: 3

Objectif: The student will understand assembly technologies, related material handling functionalities, gripping techniques and the linkage to logistics. They can evaluate product design for assembly. The students know machinery and equipment for manual and automated assembly processes and are aware about the specific opportunities and limitations.

Description: Subject

Hours

Extended V- process of product development

Main preconditions of product assembly

2

2

Object oriented analysis of assembly and test equipment

2

3

Machine and process availability

Design and process FMEA

2

4

Gauge, machine and process capability

2

5

Quality management, worker security, ergonomics

2

Structure of vehicle production final assembly area

Logistic, conveyor technologies

2

7

Fixation technologies

Bolting principle and process

2

8

Rear axle manual and automatic assembly and setting station

Simulation and virtual commissioning

2

9

Marriage station and palettes

2

Electric- and electronic testing, ECU communication

NHV testing

2

Wheel alignment

Sensor technologies, calibration, manual and automatic setting

3

12

Head lamp setting

Light box and image processing, calibration, setting

13

Driver assistance systems (DAS) setting

DAS sensor technology and corresponding testing and setting methods

14

Brake- and combined roll-, brake-, ABS-test rig

Measurement technology calibration

3

Langue: Anglais

Obligatoire: Oui

Professeur: TENTRUP Thomas

Assembly and testing technologies

Module: Assembly and testing technologies (Semestre 2)

ECTS: 4

Objectif: The student will understand assembly technologies, related material handling functionalities, gripping techniques and the linkage to logistics. They can evaluate product design for assembly. The students know machinery and equipment for manual and automated assembly processes and are aware about the specific opportunities and limitations.

Description:

Subject

Hours

Extended V- process of product development

Main preconditions of product assembly

2

2

Object oriented analysis of assembly and test equipment

2

3

Machine and process availability

Design and process FMEA

2

4

Gauge, machine and process capability

2

5

Quality management, worker security, ergonomics

2

Structure of vehicle production final assembly area

Logistic, conveyor technologies

2

7

Fixation technologies

Bolting principle and process

2

8

Rear axle manual and automatic assembly and setting station

Simulation and virtual commissioning

2

9

Marriage station and palettes

2

Electric- and electronic testing, ECU communication

NHV testing

2

Wheel alignment

Sensor technologies, calibration, manual and automatic setting

3

12

Head lamp setting

Light box and image processing, calibration, setting

13

Driver assistance systems (DAS) setting

DAS sensor technology and corresponding testing and setting methods

14

Brake- and combined roll-, brake-, ABS-test rig

Measurement technology calibration

3

Langue: Anglais

Obligatoire: Oui

Professeur: TENTRUP Thomas

Programming for engineers - old

Module: Programming for engineers (Semestre 2)

ECTS: 3

Objectif: The aim of the course is to teach basics of programming with modern languages (Java/Python/ C#), software engineering and applications of data analytics and visualization for engineers. The students can practically apply what they have learned in assignments and students projects.

The course consists of the following learning units:

- Introduction to programming
- Concepts of programming such as object orientation
- Principles of software development and UML
- Introduction to data analytics
- Data visualization

Course learning outcomes: Having successfully completed the module, students will be able to demonstrate knowledge and understanding of:

- Programming algorithms for solving tasks in engineering;
- Using modern tools and methods for software development;
- Being able to process different data sets and
- Utilize visualization methods on large data records.

Description: 1. Concepts of programming languages (week 1 and 2)

2. Elements of programming languages such as statements, operators, loops, variables, simple types, complex types (week 3 and 4) 3. Concepts of object oriented programming, i.e. classes, objects, methods, polymorphism (week 5 and 6)

4. Software design with UML (week 7 and 8)

5. Data structures and data visualization (week 9 and 10)

6. Business analytics (week 11 and 12)

7. Course project (week 13, 14 and 15)

Modalité d'enseignement: Lecture

Langue: Anglais

Obligatoire: Oui

Evaluation: Written or oral exam.

Remarque: "Python for Everybody"; "Python for Informatics"; both by Charles Severance

Professeur: MINOUFEKR Meysam

Programming for engineers

Module: Programming for engineers (Semestre 2)

ECTS: 4

Objectif: The aim of the course is to teach basics of programming with modern languages (Java/Python/C#), software engineering and applications of data analytics and visualization for engineers. The students can practically apply what they have learned in assignments and students projects.

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4. Software design with UML (week 7 and 8)
5. Data structures and data visualization (week 9 and 10)
6. Business analytics (week 11 and 12)
7. Course project (week 13, 14 and 15)

Langue: Anglais
Obligatoire: Oui
Evaluation: Written or oral exam.
Remarque: "Python for Everybody"; "Python for Informatics"; both by Charles Severance
Professeur: MINOUFEKR Meysam

Digital Factory Planning

Module: Digital Factory Planning (Semestre 2)
ECTS: 3
Modalité d'enseignement: 1 week of workshop
Langue: Anglais
Obligatoire: Oui
Evaluation: Mandatory attendance to the workshop - assessment at the end of the workshop

Robotics

Module: Robotics (Semestre 2)
ECTS: 4

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Modalité d'enseignement: Workshop 1 week

Langue: Anglais

Obligatoire: Oui

Professeur: HICHRI Bassem

Structural Dynamics

Module: Structural Dynamics (Semestre 2)

ECTS: 4

Objectif: The students know the theoretical foundations of discrete and continuous (longitudinal, transversal and torisional in 1D continua/structures, wave propagation in thin-walled structures) vibration problems and associated single- and multiple-degree of freedom systems. They can develop suitable models of two- and three-dimensional frame structures and know how to apply methods for the solution of the resulting system of equations of motion. The students know typical sources of structural excitation in civil and mechanical engineering and can perform first analyses based on the code (DIN).

Course learning outcomes: The students will be able to:

· Develop eligible structural models for selected constructions;

· Perform the associated vibration analysis and its critical interpretation; and

· Identify suitable modifications of structural designs in order to meet co-existing criteria such as safety, reliability and resource efficiency.

Description: Periodic and non-periodic vibration; modelling of rigid-body systems and continuous flexible structures (rods, beams, torsion, frame structures, plane structures); derivation of the set of equations of motion: synthetic and analytic method; rotational motion/constrained motion; linearisation and solution of the equation of motion; free and forced vibration of undamped and damped structures; modal analysis and modal synthesis; modal reduction.

Exemplarily, the following engineering applications are discussed in detail:

· earthquake engineering: seismic excitation, response spectrum method,

· wind engineering: wind and fluid flow excitations, flow-induced vibrations,

· bridge engineering: dynamic railway excitation,

· damping: active and passive damping devices

· rotor dynamics, aerodynamic forces: application to wind turbines.

Modalité d'enseignement: Lectures

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Langue: Anglais

Obligatoire: Non

Evaluation: Semester project with presentation and oral questioning: 40 %

Semester project with report: 60 %

Remarque:

- Lecture slides, notes on blackboard, computer framework using MATLAB;
- R. R. Craig: Structural Dynamics. John Wiley & Sons, New York (1981)
- S. D. Timoshenko; D. H. Young; W. Weaver: Vibration Problems in Engineering. Wiley, New York (1974)
- R. Gasch; K. Knothe: Strukturdynamik. Springer-Verlag, Berlin [in German]

Professeur: ZILIAN Andreas

Advanced engineering materials

Module: Advanced engineering materials (Semestre 2)

ECTS: 4

Objectif: Knowledge of structural materials (metals as ferrous and nonferrous alloys; ceramics and glasses;polymers, and composites) and their use in the view of a sustainable use of resources.

Course learning outcomes: The students will be capable to understand the different properties of the different key engineering materials and their use.

Description:

Metals:
· Ferrous alloys (carbon and low-alloy steels, high-alloy steels, cast irons) and recent developments in high-strength steel
· Nonferrous alloys (aluminium alloys, magnesium alloy, titanium alloys, and other alloys)
· Processing of metals and the influence on their properties
Ceramics and glasses:
· Crystalline ceramics
· Glasses
· Glass-ceramics
· Processing of ceramics and glasses and the influence on their properties
Polymers:
· Thermoplastic polymers
· Thermosetting polymers
· Processing of polymers
Composites:
· Fiber-reinforced composites
· Aggregate composites
· Honeycomb structures
· Properties on composites and the property averaging
· Processing of composites

Materials and our environment:
· Environmental aspects of design
· Recycling

Modalité d'enseignement: Lectures

Langue: Anglais

Obligatoire: Non

Evaluation: Written Examination

Professeur: USELDINGER Ralph

Machine Design Exercise

Module: Machine Design Exercise (Semestre 2)

ECTS: 3

Objectif: The goal of this course is to developed skills of students to design machine elements using gained knowledge from the completed courses (Machine Design, CAD, FEA and others) and to employ effectively this knowledge in a real design project. A focus of the course is on engineering analyses: analytical calculations of strength of material, FEA calculations, 3D design tools and finally good reporting of the project.

Course learning outcomes: The student:

* is able to work in a group, knows his place and task. He can communicate with other members and a project supervisor. He can use methods of project management

* is able to carry out a design process of a technical object

* in a practical uses computer aided tools like ANSYS and Autodesk Inventor

* solves real technical problems using previously acquired knowledge of subjects: mechanics, strength of materials, machine element design, technical drawing

* is able to propose an appropriate technological process of manufacture and assembly

Description:

* Students carry out projects in groups of 2-3 people

* Creative formulating and discovering technical problems

* Finding solutions and analyses of issues

* A selection of an optimum concept and its innovation

* An accomplishment of strength calculations and technical documentation using computer aided systems

* Special consideration of manufacturability design aspects

* Aiming to verify the solutions adopted to reach the prototype stage

* Create a final report of the project ready for a public presentation

Modalité d'enseignement: Projects

Langue: Anglais

Obligatoire: Non

Evaluation: Projects

Remarque: Literature / Litérature:

· The course materials

· ANSYS Workbench Training Materials

· "Fundamentals of Machine Elements, Third Edition: SI Version", Steven R. Schmid, Bernard J. Hamrock, Bo. O. Jacobson

Supplementary Literature:

· "Fundamentals of Machine Components Design", R. C. Juvinall, Kurt M. Marshek

Professeur: KEDZIORA Slawomir

Advanced Control

Module: Advanced Control (Semestre 2)

ECTS: 3

Objectif: Stability analysis
Control design

Course learning outcomes: System analysis in time and frequency domains
State space models
Closed loop control systems
Pole placement

Description: Introduction
Basics
Control
Mathematical Models of Systems
Introduction
Properties of CLTI Systems
Linearization
Solution of DEQ
Transfer Functions

Analysis of Linear Dynamic Systems
Basic Systems
Frequency Response
Analysis of Closed-Loop Control Systems
Introduction
Stability
Steady-State error
Root Locus
Design of Closed-Loop Control Systems
Requirements
Basic Combinations
Basic Methods
Root Locus Method
Bode Plots
Meaning of Zeros for System Dynamics

Langue: Anglais

Obligatoire: Non

Evaluation: Written examination

Remarque: Literature:
Merz, L.; Jaschek, H.: Grundkurs der Regelungstechnik. 15. Aufl. München: Oldenbourg Verlag, 2003.
Jaschek, H.; Schwinn, W.: Übungsaufgaben zum Grundkurs der Regelungstechnik. München: Oldenbourg Verlag, 2003.
Dorf, R.; Bishop, R.: Modern Control Systems. Prentice-Hall, 2001.

Professeur: CHAIB DRAA Khadidja

Networked Feedback Systems

Module: Networked Feedback Systems (Semestre 2)

ECTS: 5

Objectif: The objective of this course is to introduce students to networked feedback structures in interconnected information and communication technology in technical environments

Course learning outcomes: * Identify feedback structures, decompose them and formulate continuous and sequential dynamics
* Determine reliable discrete or continuous enclosures for structure-variations and uncertainties
* Design controls with guaranteed dynamic tolerances
* Design reliable automata in technical context

Description: Introduction
- networked feedback and feedforward
- sampling, scheduling and communication
- continuous system representations
- dynamics and approximations
- systems over the binary field

- binary transfer function and stability
- combined systems and decompositions
- feedback design in multiloop structures

Modalité d'enseignement: The course is organized as a series of lectures with practical simulation exercises

Langue: Anglais

Obligatoire: Non

Evaluation: Final Exam: 70%
Project: 30%

Advanced Robotics Class 2

Module: Advanced Robotics Class 2 (Semestre 2)

ECTS: 4

Objectif: Students are expected to have:

- Knowledge of current topics in robotics
- Knowledge of programming methods in robotics
- Knowledge on Human-Robot Cooperation in Industrial Production

At the end of the course, students should be able to:

- Independently solve complex problems in robotics using sensor data and AI methods.
- Identify the different AI methods and their application in the robotics
- Program and set up robotics applications in the simulation environment.
- Identify the structure of a mobile robotic system and its component.
- Understand the kinematic structure and control strategy that can be considered in mobile robotics.
- Program and control a robotic system.
- Have knowledge about the fields and applications targeted by Soft Robots und the relevant materials und strategies.
- Identify the complementarity between humans and robots that makes them suitable for surgical assistance.
- Identify and solve problems in the field of logistics, environmental technology and health care based on the presented methods and concepts in the robotics.

Course learning outcomes: This course deals with advanced topics in robotics. Thereby the process and the tools of developing efficient and intelligent robotics applications are considered. The course covers the topics of integration of sensors, data planning and QM and TM. Furthermore, applications of robots in the automotive and aircraft industry are discussed. An introduction to Artificial Intelligence (AI) with a focus on robotics is given. Moreover, the topic of logistics and its relation to robotics is presented. In this context, the topic of mobile robotics will be addressed. The use of robotics in the environmental and health care field will also be a focus of the lecture. The students will learn the conception and realization of robotics application based on simulation.

	The goal is for students to learn how to develop an intelligent robotics application that uses sensory data and AI methods. In addition, the students will learn to use the robotics applications in the field of environmental and health care.
Description:	• Sensor technologies in robotics and inspection applications • Robotics in the automotive and aircraft • Artificial intelligence in the robotics • Mobile robots kinematics and control • Introduction to soft robots and comparison with conventional robots • Nature inspired soft robotic system • Specific challenges in disassembly and separation technologies • Disassembly-friendly connection techniques and planning • Robotics in a global computer-assisted surgery framework • Theoretical and practical aspects for the modelling and the simulation of robots • Deployment of Exoskeletons in industrial application and their control strategies
Modalité d'enseignement:	Lecture / exercice / projects
Langue:	Anglais
Obligatoire:	Non
Evaluation:	Written examination
Professeur:	HICHRI Bassem

Quality of Service in Computer Networks

Module:	Quality of service in computer networks (Semestre 2)
ECTS:	5
Objectif:	The objective of this course is to introduce quantitative measures for network performance (like throughput, error correction, delays, routing) for different network topologies to be applied to security protocols. It also sensibilises for differences between static and dynamic networks as well as centralised and de-centralised topologies concerning reliability and trust issues
Course learning outcomes:	* Describe performance metrics and list parameters of dedicated networks and protocols. * Name and reproduce definitions of relevant parameters that theoretically characterise the communication traffic incl. queues, routing and error probabilities * Analyze existing solutions according to their capabilities for throughput, error rate and security * Construct and adapt real world communication architectures and protocols with given Quality of Service requirements on the basis of the theoretical concepts
Description:	1. Intro 2. Recap: Random Processes 3. Recap: Homogeneous Markov Chains 4. Commutation Systems: Components and modules 5. Communication Traffic as Random Process 6. Routing and Flow Control

	7. Introduction to Queueing Theory 8. QoS in TCP/IP
Modalité d'enseignement:	The course is organised as a series of lectures with dedicated time slots for exercises
Langue:	Anglais
Obligatoire:	Non
Evaluation:	70% Final Exam 30% Successful preparation, submission and active participation in exercise sessions
Professeur:	ENGEL Thomas

Information Theory and Coding

Module:	Information theory and coding (Semestre 2)
ECTS:	5
Objectif:	The objective of this course is to provide an understanding of fundamental communication limits and means of approaching them
Course learning outcomes:	* Compute fundamental communication limits * Compress simple information sources * Describe the fundamental blocks of digital communication systems (physical layer) * Encode binary information with a convolutional code
Description:	The course contains: - Shannon's concept of mathematically quantising information and uncertainty for a communication setup - Explanations that both compression and error free transmission have an extremal rate which can be computed via entropy and mutual information - Methods to compress sources - Digital transmission techniques and their complexity for inter-symbol-interference channels - Simple error correction codes, convolutional codes
Modalité d'enseignement:	The course is organized as a series of theoretical lectures intermixed with exercises/ homework.
Langue:	Anglais
Obligatoire:	Non
Evaluation:	Final Exam: 75% Homework: 25%
Professeur:	SORGER Ulrich

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Semestre 3

Advanced Project / Case Study

Module: Advanced Project / Case Study (Semestre 3)

ECTS: 12

Objectif: Purpose of the case study in the third master semester is to apply your engineering learnings but even more relevant to learn scientific work, and thus to prepare your Master project.

Description: To ensure the desired broad learning, we require that the case study and the Master thesis are distinct, thus you shall work on two different projects with two different supervisors.

Langue: Anglais

Obligatoire: Oui

Evaluation: written report+ 15 mins. presentation.+ 5 mins Q&A

Remarque: BE CAREFUL: In order to ensure broad education, we require Advanced Project / Case Study & Master Thesis being supervised by different Professors.

Lean Six Sigma - Green Belt

Module: Lean Six Sigma - Green Belt (Semestre 3)

ECTS: 3

Langue: Anglais

Obligatoire: Oui

Professeur: MARIANI Thierry

Operational excellence

Module: Operational excellence (Semestre 3)

ECTS: 2

Langue: Anglais

Obligatoire: Oui

Professeur: PLAPPER Peter

Scientific writing and presentation skills

Module: Scientific writing and presentation skills (Semestre 3)

ECTS: 3

Objectif: This course aims to give students the background and confidence to write effective engineering reports and papers.

They will learn the fundamentals of effective scientific and professional writing.

Presentation skills, verbal and non-verbal communication as well as specific documents such as a CV, cover letter, abstract and executive summary will be covered.

Course learning outcomes: As a result of this course the students should be able to:

- Write an engineering or scientific paper in regards to their structure, coherence, conciseness and expressing the core idea.

- Evaluate own writing and the writing of others.

- Deliver a professional or scientific presentation.

- Write a professional CV and cover letter, as well as learn how to prepare themselves for a job interview

Description: Section 1. Professional writing

· Professional writing and professional communication

o The CV

o The cover letter

o The job interview

Section 2. Presentation skills

· Write presentations in academic and professional context

· Verbal and non-verbal communication during the presentation

Section 3. Scientific report writing

· Engineering reports

· The abstract and the executive summary

Modalité d'enseignement: Lecture

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Langue: Anglais

Obligatoire: Oui

Professeur: MOLINA Angel

Artificial Intelligence

Module: Artificial Intelligence (Semestre 3)

ECTS: 5

Objectif: Acquire general knowledge on the objectives and application domains of Artificial Intelligence, the underlying principles behind learning models, decision systems, and problem solving tools.
Understand the purpose and role of Artificial Intelligence in real life today.
Compare and contrast various Artificial Intelligence tools and techniques, ranging from search algorithms to deep learning.
Choose the right tool to solve a given task.
Evaluate the performance of the applied algorithms and the constructed models based on reliable measures and metrics.

Course learning outcomes: After attending this class the students can describe and explain the principles behind the main Artificial Intelligence techniques, tools, models and algorithms. The students understand the hypotheses and assumptions behind each technique and can reasonably predict the consequences of these assumptions. The students are capable of choosing the right tool for the job to solve a given problem.
Having chosen the optimal Artificial Intelligence technique, the students can use it to the model the problem efficiently. The students can then implement the model using their preferred programming language, tool, or software.
The students can prepare and pre-process the data related to the problem. The students can identify existing biases and know how to avoid and/or remove them. The students can act correctly to handle missing and/or corrupted data. The students understand the importance of data, and of correct and efficient data gathering techniques.
The students can correctly evaluate the performance of the model using several metrics depending on the task and problem. The students can compare the performance to that of other models. The students can verify if their underlying assumptions are correct. The students are capable of reviewing the effectiveness of the chosen technique and identifying potential improvements.
The students can present the chosen solution, the obtained model, the performance evaluation, and the identified improvements in a precise and concise fashion.

Description: The course includes the following topics:
1.General introduction to Aritificial Intelligence
2.Problem resolution, search algorithms,
3.Games, alpha-beta pruning
4.Meta-heuristics, genetic algorithms, swarm algorithms
5.Constraint programming
6.Markov Decision Processes, reinforcement learning
7.Learning models for regression, classification, clustering
8.Evaluating the performance of a learning model
9.Decision trees, forests

10.Artificial neural networks
11.Unsupervised learning, k-Nearest neighbours, self-organising maps, growing neural gas

Modalité d'enseignement: Lectures, TD & TP

Langue: Anglais

Obligatoire: Non

Evaluation: Written Examination – 70% of total mark
Group Project – 30% of total mark

Remarque: Literature:

Script, recommended literature in library of UL, exercises, TD, lab sessions
Bishop, C. M. (2006). Pattern recognition and machine learning. springer.
Mitchell, T. M. (1997). Machine learning. 1997. McGraw Hill
Russell, S. J., & Norvig, P. (2016). Artificial intelligence: a modern approach. Pearson Education Limited.

Electrical Energy Production Transportation and Distribution

Module: Electrical Energy Production Transportation and Distribution (Semestre 3)

ECTS: 3

Langue: Français

Obligatoire: Non

Energetics of the blast furnace

Module: Energetics of the blast furnace (Semestre 3)

ECTS: 3

Objectif: Introduction of industrial processes to the students in order to bridge the theory of the study and the industrial application. Technical, environmental and economical aspects are discussed and the interrelationship shall become obvious.

Description: The Blast Furnace Process:

· History and description of the Blast Furnace

· The Blast Furnace Process:

- Reduction Equations

- Thermal and mass balance

· Auxiliary plants (Hot Stoves, Sinter Plant, Pulverized Coal Injection Plant, Slag treatment, etc.)

Technical Improvements to the Blast Furnace Process with economical and environmental impacts:

· Top Gas Recovery Turbine

· Coal Grinding and Drying & Pulverized Coal Injection

· Slag Granulation to create a substitute for cement clinker

· Heat recovery system at the Hot Stoves

Langue: Anglais

Obligatoire: Non

Evaluation: Written exam

Professeur: BANIASADI Maryam

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Semestre 4

Master thesis

Module:	Master thesis (Semestre 4)
ECTS:	30
Langue:	Anglais
Obligatoire:	Oui
Remarque:	BE CAREFUL: In order to ensure broad education, we require Advanced Project / Case Study & Master Thesis being supervised by different Professors.