# M.Sc. Systems Engineering and Engineering Management

## Module Descriptions

Version: 12 July, 2016

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<tr>
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<tr>
<td>Systems Engineering</td>
<td>24</td>
</tr>
<tr>
<td>Technical Publications and Presentations</td>
<td>26</td>
</tr>
</tbody>
</table>
1. Advanced Control Technology (ET)

<table>
<thead>
<tr>
<th>1. CODE</th>
<th>EEM4015</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. TITLE</td>
<td>Advanced Control Technology (ET)</td>
</tr>
<tr>
<td>3. PATHWAY</td>
<td>ET</td>
</tr>
<tr>
<td>4. INSTRUCTOR</td>
<td>Prof. Dr.-Ing. Sigrid Hafner</td>
</tr>
<tr>
<td>5. CREDITS</td>
<td>ECTS 8 (15)</td>
</tr>
</tbody>
</table>

6. DESCRIPTION AND PURPOSE OF MODULE – studying this module involves the following:

Characterization of systems using state space equations; Design and optimization of state space controllers; Comparison to other methods e.g. conventional PID control with transfer functions, Analysis of control concepts using Matlab Simulink;

Nonlinear modelling with basic principles of Computational Intelligence with the two methods Neural Networks and Fuzzy Systems are discussed and compared to conventional linear control in theory and application.

The goal is a mapping of these ideas into the application area on a research –oriented level with a deeper insight into modern advanced control technology and systems theory. Presentation and discussion of theory and of results of practical exercises in a scientific research oriented way in English.

Knowledge Prerequisites:
A basic lecture in feedback control systems is required for this module with the following topics
- Differential equations, Linear time invariant (LTI)- system modelling, Linear control loop elements
- Basic understanding of block diagrams
- Linear versus nonlinear models and basic linearization
- Transfer functions, frequency response
- Development and Simulation (e.g. Matlab Simulink) of PID controllers for LTI-systems
- Stability and at least one Criteria (Nyquist or Routh-Hurwitz criterion)
- Basic tuning (e.g. Ziegler and Nichols) and evaluation of controlled loops by performance criteria

7. INDICATIVE SYLLABUS CONTENT – the topics you may encounter on this module include:

State Space:
State space modelling of dynamical systems – theory and applications
State space equations and transfer functions,
Stability, Controllability, Observability,
State feedback control design
Comparison conventional control with PID and transfer functions to state space controlled system.
Simulation of state space system using Matlab Simulink

Linear and Nonlinear Control:
Fuzzy Control: Methods and Concepts for modelling and control, Fuzzy Controller (e.g. Mandami Controller) in application (Matlab Simulink simulations). Neural Network Control: Methods and Concepts for modelling and control, Multi-layer Perceptron, Back Propagation, Neural Controller in applications, Matlab Programming.
Comparison of these techniques with a linear approximated control model near an equilibrium point in applications (e.g. Water level tank application in our Lab) is given and the limitations of the systems are discussed.

Programming in Matlab and Simulink. Discussion of complex linear and nonlinear problems in the area of control engineering.

8. LEARNING, TEACHING AND ASSESSMENT – this module is delivered and assessed in the following ways:

ECTS workload:

<table>
<thead>
<tr>
<th>Coursework</th>
<th>Total No Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures:</td>
<td>50 hours</td>
</tr>
<tr>
<td>Computer based exercises and lab:</td>
<td>30 hours</td>
</tr>
<tr>
<td>Discussion / Review /Tutorial:</td>
<td>25 hours</td>
</tr>
<tr>
<td>Coursework:</td>
<td>2 x 30 hours</td>
</tr>
<tr>
<td>Directed reading:</td>
<td>25 hours</td>
</tr>
<tr>
<td>Exam preparation:</td>
<td>50 hours</td>
</tr>
<tr>
<td><strong>Total No Hours</strong></td>
<td><strong>240 hours</strong></td>
</tr>
</tbody>
</table>
9. Learning Outcomes and Assessment Criteria:

**LEARNING OUTCOMES** – when you have successfully completed this module you will:

1. Be able to describe dynamical systems in mathematical terms using state space representations, block diagrams or transfer functions and compare the advantages and disadvantages.
2. Understand to design controllers using state space pole assignment and/or observers. Compare solutions to conventional controller e.g. Phase lead and phase lag feedback compensators, Case studies.
3. Have knowledge about fuzzy mathematics and many-valued logic. Be able to design a fuzzy controller.

**ASSESSMENT CRITERIA** - to demonstrate that you will have achieved the learning outcome you will:

1. Develop a detailed understanding of modelling for linear and nonlinear time invariant plants in engineering with different methods and understand their properties. Point out the advantages and disadvantages of using different methods in modelling.
2. You will be able to design a state space controller and analyse its advantage and disadvantages to conventional PID controllers, implemented with transfer functions.
3. Analyse the requirement and derive technical specifications for fuzzy systems. You are able to design a fuzzy controller with own coding in Matlab and to evaluate its performance compared to other methods.
4. Evaluate, select and use appropriate data and design for the development of a neural controller. You are able to compare the performance to other solutions and you can explain the advantages and disadvantages.

10: ASSESSMENT ITEMS – your achievement of the learning outcomes for this module will be tested as follows:

<table>
<thead>
<tr>
<th>Assessment type:</th>
<th>Combined form of examinations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ASSESSMENT ITEM NUMBER</strong></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td><strong>Type</strong></td>
<td>PRA, PRE, CW</td>
</tr>
<tr>
<td><strong>Description</strong></td>
<td>E.g.:</td>
</tr>
<tr>
<td></td>
<td>a) The task is to control a given plant using different techniques. There will be a simulation in Matlab Simulink and practical application in the lab. In a presentation you will show your solution and answer questions. or b) Analysis, design and implementation task. Assessment will be based on quality of analysis, theoretical background knowledge, design, function, documentation.</td>
</tr>
<tr>
<td><strong>Percent of mark</strong></td>
<td>50</td>
</tr>
</tbody>
</table>

Each assessment item in the module to be entered separately

**Type:**
- AO - Attendance only
- Cw - Coursework
- EX - Examination
- ICA - In-class Assignment
- PRA - Practical work
- PRE - Presentation
- IS - Independent Study, dissertation or project

**Description** – Text description of type of assessment. For example:
- Cw - Essay of 2,000 words
- EX - Open Book examination
- IS - Dissertation, 10,000 words

**Percentage of Mark** - Percentage weighting for each item of assessment
### 11. INDICATIVE READING - amongst some of the materials you may be required to consult are: (up to 15 titles with date of publication)

<table>
<thead>
<tr>
<th>Author(s)</th>
<th>Title</th>
<th>Publisher</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Messner B., Tilbury D.</td>
<td>Control Tutorials for Matlab&amp;Simulink</td>
<td></td>
<td>2012</td>
</tr>
<tr>
<td>Winston P.</td>
<td>Learning: Neural Nets, Back propagation, MIT OpenCourseWare</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>MIT 6.034 Artificial Intelligence, Fall 2010</td>
<td><a href="http://ocw.mit.edu/6-034F10">http://ocw.mit.edu/6-034F10</a></td>
<td></td>
</tr>
</tbody>
</table>

Lecture notes: Advanced Control: S. Hafner, South Westphalia University of Applied Sciences

### 12. VERSION NUMBER: 1.0
2 Advanced Control Technology (ME / MT)

<table>
<thead>
<tr>
<th>1. CODE</th>
<th>EEM4015-2</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. TITLE</td>
<td>Advanced Control Technology (ME / MT)</td>
</tr>
<tr>
<td>3. PATHWAY</td>
<td>ME / MT</td>
</tr>
<tr>
<td>4. INSTRUCTOR</td>
<td>Prof. Dr.-Ing. Andreas Schwung</td>
</tr>
<tr>
<td>5. CREDITS</td>
<td>ECTS 8 (15)</td>
</tr>
</tbody>
</table>

6. DESCRIPTION AND PURPOSE OF MODULE – studying this module involves the following:

This research-oriented module enables the student to understand modern control techniques and the basic principles of Computational Intelligence often called Soft Computing with the two parts Neural Networks and Fuzzy Systems. The student should be familiar with the analytical methods of modelling and design of intelligent and cognitive systems for modern control and management. The goal is a mapping of the novel ideas into the application area on a research-oriented level with a deeper insight into modern advanced control technology and systems theory.

7. INDICATIVE SYLLABUS CONTENT – the topics you may encounter on this module include:

The module covers the area of advance control technology with special emphasis on the design of control systems for mechanical systems. To this end model based control design together with the usage of modern simulation software is applied. In detail this module covers the following topics:

Simulation systems:
Use of current software packages applying linear mathematics, using both analytical and numerical techniques, to achieve the following:
Data analysis and visualisation
Interactive programming, use of menu systems
Understand the limitation of simulation systems
Design of interactive models.
Simulation and model based design of control systems

Modelling and control of mechanical systems
Control oriented modelling with special emphasis on mechanical systems
Controller design based on frequency response method
State-Space approach
Design of state feedback controller and state feedback observer
Stability of dynamic systems
Nonlinear System Analysis
Nonlinear Controller design based on feedback linearization
Model Predictive control
Fuzzy Systems
Fuzzy Control

8. LEARNING, TEACHING AND ASSESSMENT – this module is delivered and assessed in the following ways:

This module is split between formal lectures, tutorials and computer-based practical work. Teaching is based around handouts containing course material and simulation examples of real systems. Assigned reading, tutorial and lectures will also be used to import knowledge.

ECTS workload:

<table>
<thead>
<tr>
<th>Learning, Teaching, and Assessment</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures:</td>
<td>60</td>
</tr>
<tr>
<td>Computer based exercises:</td>
<td>20</td>
</tr>
<tr>
<td>Discussion / Review / Tutorial:</td>
<td>25</td>
</tr>
<tr>
<td>Coursework:</td>
<td>60</td>
</tr>
<tr>
<td>Directed reading:</td>
<td>25</td>
</tr>
<tr>
<td>Exam preparation:</td>
<td>50</td>
</tr>
<tr>
<td><strong>Total No Hours</strong></td>
<td><strong>240</strong></td>
</tr>
</tbody>
</table>
## 9. Learning Outcomes and Assessment Criteria:

<table>
<thead>
<tr>
<th>LEARNING OUTCOMES – when you have successfully completed this module you will:</th>
<th>ASSESSMENT CRITERIA - to demonstrate that you will have achieved the learning outcome you will:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Be able to develop models of engineering systems in the field of electrical and mechanical engineering.</td>
<td>1 Constitute the differential equations of a system from its given attributes. Generate the state equations from a differential equation $n^{th}$ order. Generate state space system from a given system description.</td>
</tr>
<tr>
<td>2 Be able to use current software simulation tools</td>
<td>2 Solve differential equations with two different and common used software tools. Design appropriate system models by means of simulation software. Describe the limits of simulation tools.</td>
</tr>
<tr>
<td>3 Be able to analyse nonlinear systems and design controller for them</td>
<td>3 Understand and use basic notions of stability of nonlinear systems. Identify needs for nonlinear controller design. Be able to apply nonlinear control methods to a given control problem. Compare the controller performance by means of suitable criterias.</td>
</tr>
<tr>
<td>4 Be able to design and implement fuzzy systems</td>
<td>4 Analyse the requirement and derive technical specifications for fuzzy systems. Compute fuzzy inferences and use different methods of Defuzzification. Explain the structure of Fuzzy Systems and know methods of Sugeno and Mamdani controllers.</td>
</tr>
</tbody>
</table>

## 10: ASSESSMENT ITEMS – your achievement of the learning outcomes for this module will be tested as follows:

<table>
<thead>
<tr>
<th>Assessment type: Combined form of examinations</th>
<th>ASSESSMENT ITEM NUMBER</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Type</td>
<td>PRA, PRE, CW</td>
</tr>
<tr>
<td>Description</td>
<td>E.g.: a) The task is to construct the model of a given system using different software tools, and to determine differences and possibilities. or b) Usage of a software tool to depict some basics of fuzzy logic. And a manual, analytical solution of a given fuzzy set.</td>
</tr>
<tr>
<td>Percent of mark</td>
<td>50</td>
</tr>
</tbody>
</table>

Each assessment item in the module to be entered separately

Type:  
AO - Attendance only  
Cw - Coursework  
EX - Examination  
ICA - In-class Assignment  
PRA - Practical work  
PRE - Presentation  
IS - Independent Study, dissertation or project

Description – Text description of type of assessment. For example:

Cw - Essay of 2,000 words  
EX - Open Book examination  
IS - Dissertation, 10,000 words

Percentage of Mark - Percentage weighting for each item of assessment
11. INDICATIVE READING - amongst some of the materials you may be required to consult are: (up to 15 titles with date of publication)
Ogata, K., Modern Control Engineering, 2010
Dorf, R., Bishop, R., Modern Control Systems, 2011
Franklin, G., Powell, D., Emami-Naeini, A., Feedback Control of Dynamic Systems, 2006
Passino,K., Yurkovich,S., Fuzzy Control, 1998

12. VERSION NUMBER: 1.0
### 3 Advanced Production Engineering

<table>
<thead>
<tr>
<th>1. CODE</th>
<th>EEM4019</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. TITLE</td>
<td>Advanced Production Engineering</td>
</tr>
<tr>
<td>3. PATHWAY</td>
<td>ME / MT</td>
</tr>
<tr>
<td>4. INSTRUCTOR</td>
<td>Prof. Dr.-Ing. Thorsten Frank</td>
</tr>
<tr>
<td>5. CREDITS</td>
<td>ECTS 8 (15)</td>
</tr>
</tbody>
</table>

**6. DESCRIPTION AND PURPOSE OF MODULE** – studying this module involves the following:

Students will be able to leverage their knowledge and skills in management and control of the overall production system and in areas related to production system design and improvement. They will master different methods used to analyze and approach the value stream of a single production or a production network. Important is beside the technical system of production also to get a deep understanding of the organizational environment to consist of management infrastructure or culture of a company.

The basic objectives are as follows:

- understand modern production technologies and philosophies for mass and medium size customized series and, based on this, formulate and solve operational and strategic problems in design, operation and improvement of the manufacturing systems in a single production or production network
- master modern reengineering and improvement tools in manufacturing, and methods used in analyzing performance of the production system
- understand relations between customer orders and demand and the resulting shop orders, via the process of manufacturing planning and control
- understand and analyze how manufacturing interplay with economic, organizational and business issues of the firm, and be able to formulate an operational manufacturing strategy like Lean production or the Toyota production system
- be an expert in manufacturing process control and optimization, often with the purpose to improve production economics and efficiency with help of the value stream design or the continuous improvement process on the shop floor
- be an expert in design of organizations with flat hierarchies and a leadership based on coaching principles
- be an invaluable team worker/project leader as a production process expert in any situation of interdisciplinary physical product development.

**7. INDICATIVE SYLLABUS CONTENT** – the topics you may encounter on this module include:

- Introduction: Production or supplier network
- Classic way of production planning and control
- Method of value stream mapping
- Best practice of Toyota Production Systems / Lean Production: Success Story of Porsche
- Lean Elements – Elements of optimization a technical production system (1)
- Shop Floor Management – Element of optimization of the emotional production system (2)
- Learning to work and create a Kaizen Workshop to optimize the assembly flow with help of a U-Cell
- Discussion the book “Journey to Lean – a change process story”
- Preparing additional and special topics, presentation in small teams & following discussion

**8. LEARNING, TEACHING AND ASSESSMENT** – this module is delivered and assessed in the following ways:

Lectures, seminars, practical exercise, case studies, reports from external experts and visits to industrial plants. There is a strong emphasis on project work which is assessed through practical demonstration, report, writing and oral presentation.

**ECTS workload:**

<table>
<thead>
<tr>
<th>Activity</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures</td>
<td>55</td>
</tr>
<tr>
<td>Computer based exercises</td>
<td>0</td>
</tr>
<tr>
<td>Discussion / Review / Tutorial</td>
<td>55</td>
</tr>
<tr>
<td>Coursework</td>
<td>3 x 30</td>
</tr>
<tr>
<td>Directed reading</td>
<td>40</td>
</tr>
<tr>
<td><strong>Total No. Hours</strong></td>
<td>240</td>
</tr>
</tbody>
</table>

**9. Learning Outcomes and Assessment Criteria:**

<table>
<thead>
<tr>
<th>LEARNING OUTCOMES – when you have successfully completed this module you will:</th>
<th>ASSESSMENT CRITERIA - to demonstrate that you will have achieved the learning outcome you will:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. have a systematic understanding of modern advanced mechanical systems with manufacturing or assembly processes and production management for flexible customized series production</td>
<td>1. have communication and presentation skills appropriate to modern production systems in different branches</td>
</tr>
</tbody>
</table>
2 have understanding of industrial processes for production system environment and network

2 • analyse practical situations and generate solutions to problems arising in the field
• organise efficient team work by means of clear organisational structures and optimised communication within a corporate working atmosphere

3 have knowledge of improvement tools and techniques in different contexts based on Lean philosophy

3 • able to undertake successfully an extended project in failure and process analysis

4 have a comprehensive knowledge of methods, and tools to manage complexity and control of advanced production systems

4 • have to skills to optimize the value stream with help of important lean elements

10: ASSESSMENT ITEMS – your achievement of the learning outcomes for this module will be tested as follows:

Assessment type: Project work

ASSESSMENT ITEM NUMBER

1

Type CW, PRE, PRA

Description a) Written assignment about defined special production process topics
Extant: ~2400 words
Presentation of the paper and / or
b) Assignment about optimization of a production system of a product family with help of value stream mapping method

Percent of mark 100

Each assessment item in the module to be entered separately

Type: AO - Attendance only
Cw - Coursework
EX - Examination
ICA - In-class Assignment
PRA - Practical work
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Description – Text description of type of assessment. For example:
Cw - Essay of 2,000 words
EX - Open Book examination
IS - Dissertation, 10,000 words

Percentage of Mark - Percentage weighting for each item of assessment

11. INDICATIVE READING - amongst some of the materials you may be required to consult are: (up to 15 titles with date of publication)

[OHN-93] Ohno, Taiichi: „Das Toyota Produktionssystem“; Campus, 1993


[ROT-99] Rother, Mike; Shook, John: “Learning to See: Value-Stream Mapping to Create Value and Eliminate Muda: Value Stream Mapping to Add Value and Eliminate Muda “, Lean Management Institut, 1999


[HER-10] Herbek, Peter: „Strategische Unternehmensführung“; mi-Verlag, 2010

12. VERSION NUMBER: 1.0
# Business in Engineering

<table>
<thead>
<tr>
<th>1. CODE</th>
<th>EEM4013</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. TITLE</td>
<td>Business in Engineering</td>
</tr>
<tr>
<td>3. PATHWAY</td>
<td>ET / ME / MT</td>
</tr>
<tr>
<td>4. INSTRUCTOR</td>
<td>Prof. Dr. Henrik Janzen</td>
</tr>
<tr>
<td>5. CREDITS</td>
<td>ECTS 7(15)</td>
</tr>
</tbody>
</table>

## 6. DESCRIPTION AND PURPOSE OF MODULE – studying this module involves the following:

There is a strong need for engineers to deal with essential elements of management, especially in developing and marketing of technologies. Theoretical understanding of this field makes interdisciplinary teamwork, planning and leading more effective.

The aims of this module are to enable the student to participate in entrepreneurial management processes concerning the setting of targets, planning and marketing. This should be based on a system-theoretical understanding of the company and the ability to create and use models for analysis and solving of problems.

## 7. INDICATIVE SYLLABUS CONTENT – the topics you may encounter on this module include:

- Introduction: understanding management
- The institutional view of management
- The functional view of Management: planning, organizing, controlling, leading, and deciding
- The strategic and the operational level of management and their connection
- Techniques and instruments of operational management
- Techniques and instruments of strategic management
- Marketing as „market-oriented management”
- Marketing of technologies: the concept of „business to business” marketing
- Excursus: costs and benefits
- Basic principles of „business to business” marketing
- Analyzing strengths and weaknesses, opportunities and threats in competition
- Defining the marketing-mix: product development, pricing, communication and distribution

## 8. LEARNING, TEACHING AND ASSESSMENT – this module is delivered and assessed in the following ways:

Lectures and discussions in every topic. Case-studies to train analytic and modelling skills, especially related to the management of technologies. Role-play and case-studies to train business-to-business marketing.

**ECTS workload:**

<table>
<thead>
<tr>
<th>Activity</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures</td>
<td>60</td>
</tr>
<tr>
<td>Discussion /review /tutorial</td>
<td>40</td>
</tr>
<tr>
<td>Coursework</td>
<td>80</td>
</tr>
<tr>
<td>Directed reading</td>
<td>30</td>
</tr>
<tr>
<td><strong>Total No Hours</strong></td>
<td><strong>210</strong></td>
</tr>
</tbody>
</table>

## 9. Learning Outcomes and Assessment Criteria:

<table>
<thead>
<tr>
<th>LEARNING OUTCOMES – when you have successfully completed this module you will:</th>
<th>ASSESSMENT CRITERIA - to demonstrate that you will have achieved the learning outcome you will:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Have knowledge and understanding of management both as a function and an institution</td>
<td>1. Discuss the focus of Management within the business environment.</td>
</tr>
<tr>
<td>2. Have knowledge and understanding of basic management techniques and instruments</td>
<td>2. Describe management Instruments and their conditions for use within business situations.</td>
</tr>
<tr>
<td>3. Understand and be able to apply the benefit of management instruments in a practical environment</td>
<td>3. Practice the use of management instruments in realistic business environments as identified in case studies.</td>
</tr>
<tr>
<td>4. Understand the role of markets in developing and selling of products and technologies</td>
<td>4. Be able to recognise and implement the stages of innovation in taking a product from conception to sales.</td>
</tr>
<tr>
<td>5. Have knowledge and understanding of the marketing concept as „market-oriented” management</td>
<td>5. Compare management and marketing conceptions and apply them to typical business environments.</td>
</tr>
<tr>
<td>6. Have knowledge and understanding of the principles and instruments of „business to business”-marketing</td>
<td>6. Discuss and compare business-to-business and business-to-consumer marketing, and be able to select models appropriate particular business scenarios.</td>
</tr>
<tr>
<td>7. Be able to solve „business to business”-marketing problems (in case studies)</td>
<td>7. Apply business-to-business marketing to practical situations identified in case studies.</td>
</tr>
<tr>
<td>8. Have knowledge and understanding of technology-selling situations</td>
<td>8. Assess, critically analyse, develop and present a business presentation.</td>
</tr>
</tbody>
</table>
10: ASSESSMENT ITEMS – your achievement of the learning outcomes for this module will be tested as follows:

<table>
<thead>
<tr>
<th>Assessment type:</th>
<th>Project work</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASSESSMENT ITEM NUMBER</td>
<td>1</td>
</tr>
<tr>
<td>Type</td>
<td>CW/PRE</td>
</tr>
</tbody>
</table>
| Description | a) Development and presentation of a business-to-business selling situation (role-play)  
And / or  
b) Essay about different asserted problems and cases |
| Percent of mark | 100 |

Each assessment item in the module to be entered separately

Type:  
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Cw - Essay of 2,000 words  
EX - Open Book examination  
IS - Dissertation, 10,000 words

Percentage of Mark - Percentage weighting for each item of assessment

11. INDICATIVE READING - amongst some of the materials you may be required to consult are: (up to 15 titles with date of publication)

5 Integrated Management Systems

1. CODE EEM4020
2. TITLE Integrated Management Systems
3. PATHWAY ET / ME / MT
4. INSTRUCTOR Prof. Dr. Andreas Gerlach
5. CREDITS ECTS 7 (15)

6. DESCRIPTION AND PURPOSE OF MODULE – studying this module involves the following:
The module offers an introduction into integrated management systems (IMS). Increasing complexity and the
dynamics of challenges that have to be mastered by an organisation’s management has led to a high degree of
specialisation and division of work. However, isolated solutions for individual problems are not efficient. Therefore,
an integrated management system (IMS) combines all related components of a business into one system for more
efficient management and operations. Quality, Environmental, and Safety management systems are often combined
and managed as an IMS. These systems are not separate systems that are later combined, rather they are
integrated with linkages so that similar processes are seamlessly managed and executed without duplication.
The course introduces tools and methods of holistic approaches to quality management and environmental
management. In addition, the course will provide an introduction into innovation management and the challenge of
integrating innovation into an organization’s IMS.

7. INDICATIVE SYLLABUS CONTENT – the topics you may encounter on this module include:

Quality Management:
• Perspectives on quality
• Objectives of integrated quality management systems
• ISO 9000 systems
• Total Quality Management
• Six Sigma

Environmental Management:
• Objectives and motivation of environmental protection
• Activities and procedures to set up an EMS
• Environmental policy and review
• Structure of ISO14000/14001
• Environmental Management Manual

Innovation Management:
• Solution oriented creativity techniques
• Invention vs. Innovation
• Innovation management: Principles, tools and methods
• Project assessment and selection
• Implementation of innovation
• Capturing innovation

8. LEARNING, TEACHING AND ASSESSMENT – this module is delivered and assessed in the following
ways:
Lectures, seminars, practical exercises, case studies, reports from external experts and visits to industrial plants.
There is a strong emphasis on project work which is assessed through practical demonstration, report, writing and
oral presentation.
ECTS workload:

<table>
<thead>
<tr>
<th>Lectures:</th>
<th>50 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computer based exercises</td>
<td>20 hours</td>
</tr>
<tr>
<td>Discussion / Review / Tutorial:</td>
<td>20 hours</td>
</tr>
<tr>
<td>Coursework:</td>
<td>3 x 20 &amp; 1 x 30 hours</td>
</tr>
<tr>
<td>Directed reading:</td>
<td>30 hours</td>
</tr>
<tr>
<td>Total No. Hours</td>
<td>210 hours</td>
</tr>
</tbody>
</table>

9. Learning Outcomes and Assessment Criteria:

<table>
<thead>
<tr>
<th>LEARNING OUTCOMES – when you have successfully completed this module you will:</th>
<th>ASSESSMENT CRITERIA - to demonstrate that you will have achieved the learning outcome you will:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 have a good understanding of integrated management systems</td>
<td>be able to reflect the necessity of integrating management systems</td>
</tr>
<tr>
<td>2 understand the nature and of quality management, and environmental management as holistic approaches</td>
<td>be able to explain relevant management methods and tools for successful quality management and environmental management</td>
</tr>
<tr>
<td>3 be able to successfully contribute to TQM-, ISO 9000-, Six Sigma-, and ISO 14000/14001 processes in organizations</td>
<td>be able to describe and analyse case studies in the area of quality management and environmental management</td>
</tr>
<tr>
<td>4 understand innovation management as a process and a major management responsibility</td>
<td>be able to explain and apply relevant methods and tools for project search, selection, implementation and capturing</td>
</tr>
</tbody>
</table>
10: ASSESSMENT ITEMS – your achievement of the learning outcomes for this module will be tested as follows:

<table>
<thead>
<tr>
<th>Assessment type: Project work</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASSESSMENT ITEM NUMBER</td>
</tr>
<tr>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CW/PRE</td>
<td>a) Assignment related to quality management or environmental management in an organisation and / or b) Assignment related to innovation management in an organisation</td>
</tr>
</tbody>
</table>

| Percent of mark | 100 |

Each assessment item in the module to be entered separately

Type: 
- AO - Attendance only
- Cw - Coursework
- EX - Examination
- ICA - In-class Assignment
- PRA - Practical work
- PRE - Presentation
- IS - Independent Study, dissertation or project

Description – Text description of type of assessment. For example:
- Cw - Essay of 2,000 words
- EX - Open Book examination
- IS - Dissertation, 10,000 words

Percentage of Mark - Percentage weighting for each item of assessment

11. INDICATIVE READING - amongst some of the materials you may be required to consult are: (up to 15 titles with date of publication)

Caplen – The Quality system: A sourcebook for managers and engineers. Chilton 1980
P. Crosby " Quality is free" McGraw Hill 1978


12. VERSION NUMBER: 1.0
6 International Project Management

<table>
<thead>
<tr>
<th>1. CODE</th>
<th>EEM4017</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. TITLE</td>
<td>International Project Management</td>
</tr>
<tr>
<td>3. PATHWAY</td>
<td>ET / ME / MT</td>
</tr>
<tr>
<td>4. INSTRUCTOR</td>
<td>Prof. Dr. Florian Dörrenberg</td>
</tr>
<tr>
<td>5. CREDITS</td>
<td>ECTS 7 (15)</td>
</tr>
</tbody>
</table>

6. DESCRIPTION AND PURPOSE OF MODULE – studying this module involves the following:

Just in time development of new products requires a systematic approach using the methodology of modern project management. A basic knowledge is essential for engineers from all disciplines. This module offers an introduction into international project management on various levels of the system (project – programme – portfolio).

Increasing complexity and the dynamics of change are challenges that have to be mastered by an organisation’s management which has led to a high degree of specialisation and division of work. However, isolated solutions for individual problems are not efficient. The (young) engineer in his role as manager has to cooperate with others and has to coordinate the work within projects across functional boundaries. He needs background knowledge and some expertise in leading a team as well as a serious understanding about related aspects of systems engineering (e.g. requirements analysis, integration management).

Obviously, there is a strong need for engineers to deal with essential elements of management, commercial issues and inter-personnel relationship. Having – at least - heard the theoretical background of this field makes interdisciplinary teamwork, planning and leading more effective.

One of the guiding motivations is transfer: from theory to practice, between students based on their own experience as well as between the various levels of a hierarchy within an organisation. Life-long-learning is essential for the younger generation of managing engineers.

7. INDICATIVE SYLLABUS CONTENT – the topics you may encounter on this module include:

The module consists of 5 focus themes which are overlapping.

1. Start-Up (Case Study)
   - International case study done in mixed project teams (experience the intercultural richness)
   - Introduction: understanding project management

2. PM Basics (Lecture)
   - Historical background
   - Characteristics of a project
   - Relevance of the “Magic Triangle” (cost, time, performance)
   - Standards and Non-Profit-Organisations (PMI, IPMA)
   - Project- and product lifecycle
   - Total Cost of Ownership approach (TCO)
   - Working in a multi-project environment: Project – Programme – Portfolio
   - Roles and responsibilities of Client, PM, team members and steering committee
   - Essentials of Stakeholder Management, including commitment of project team members
   - Achieving business benefits through projects – the customer’s perspective
   - Generic Project management model (linked with Stage Gate Concept)
   - Project-specific phase model including milestones
   - Initiation of projects
   - Project Charter
   - Scope
   - Work Breakdown Structure (WBS)
   - Scheduling and resource allocation
   - Forecast of sales, cash flow and break-even

3. PM Applied (Software training)
   - Hands-On training at computer lab with Software MS-Project
   - Application of planning tools in a (smaller) case study
   - Understanding the interdependencies between planning elements of a project
   - Developing a reasonable basic project plan

4. PM Advanced (Presentations)
   - In-depth presentations by intercultural mixed student teams on selected advanced topics in 4 sequences:
     - Technical PM
     - Legal, Political and Financial Aspects
     - Projects in specific situations
     - Soft skills for project managers.
   - Developing a suitable HandOut as management summary in a given format.
5. Close-Down (Lecture)
- Systematic closing of a project
- Preparation for after sales service
- Final project report
- Evaluation of projects performance

8. LEARNING, TEACHING AND ASSESSMENT – this module is delivered and assessed in the following ways:

Lectures and open discussions in every topic, intense interaction between students and teachers.

This module is split between formal lectures, tutorials, SW-training in the computer lab and practical work in student teams out of university. Teaching is based on the scriptum which can be downloaded, containing course material and examples of real project documents. Assigned reading, tutorial, practical labs and lectures will also be used to import knowledge.

ECTS workload:

<table>
<thead>
<tr>
<th>Activity</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures</td>
<td>48</td>
</tr>
<tr>
<td>Computer-based exercises</td>
<td>20</td>
</tr>
<tr>
<td>Discussion /review /tutorial</td>
<td>30</td>
</tr>
<tr>
<td>Assignment preparation and completion</td>
<td>46</td>
</tr>
<tr>
<td>Coursework</td>
<td>40</td>
</tr>
<tr>
<td>Directed reading</td>
<td>26</td>
</tr>
<tr>
<td>Total No. Hours</td>
<td>210</td>
</tr>
</tbody>
</table>

9. Learning Outcomes and Assessment Criteria:

<table>
<thead>
<tr>
<th>LEARNING OUTCOMES – when you have successfully completed this module you will:</th>
<th>ASSESSMENT CRITERIA - to demonstrate that you will have achieved the learning outcome you will:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Understand what characterises a project in terms of cost, time and performance. How these are interpreted as target outcomes of projects.</td>
<td>1 Describe the main characteristics of project management. This will set the subject in its historical context and illustrate the roles and characteristics of all those involved in project management.</td>
</tr>
<tr>
<td>2 Have knowledge and understanding of the historical background of project management.</td>
<td>2 Be able to explain and apply context-related relevant methods and tools for project selection, initiation and implementation.</td>
</tr>
<tr>
<td>3 Have knowledge and understanding of what is the project manager's responsibility.</td>
<td>3 Have gained own experience as member of an international project team bridging the gap of language and perception.</td>
</tr>
<tr>
<td>4 Understand project management as relevant interdisciplinary approach and a major management challenge</td>
<td>4 Practice the use of appropriate project management tools and instruments in realistic business environments as identified in case studies</td>
</tr>
<tr>
<td>5 Have knowledge about the difference between project, program and portfolio and understand the interconnections and priorities in a multi-project environment.</td>
<td>5 Critically appraise a project and after analysis, design a project management plan using the computer program MS project. This project plan will show the work breakdown structure, introduce milestones, allocate resources and show the cost versus time as well as the load of resources.</td>
</tr>
<tr>
<td>6 Have a knowledge and understanding of project team members, team psychology and how to motivate the team to meet the commitments of project.</td>
<td>6 Assess, critically analyse, develop and present a business presentation in the right context</td>
</tr>
</tbody>
</table>
10: ASSESSMENT ITEMS – your achievement of the learning outcomes for this module will be tested as follows:

<table>
<thead>
<tr>
<th>Assessment type:</th>
<th>Project work</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>ASSESSMENT ITEM NUMBER</th>
<th>1</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Type</th>
<th>CW / PRE / IS / PRA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td></td>
</tr>
<tr>
<td>a) Team-Presentation about an advanced topic in Project Management And / or</td>
<td></td>
</tr>
<tr>
<td>b) Learning Logbook Written report with a very individual reflection on own performance as adult learner; maximum 2 pages per lecture unit (total: approx. 25 pages) And / or</td>
<td></td>
</tr>
<tr>
<td>c) Individual implementation of a Project Plan using Microsoft Project Student shall implement a detailed Project Plan using Microsoft Project as design tool. This plan shall include details regarding project structure, phases, tasks, resources, costs, and other related details; which reflect the student knowledge about project planning, using MS Project as a design tool, and optimization the usage of project resources.</td>
<td></td>
</tr>
</tbody>
</table>

Percent of mark | 100 |
---|---|

Each assessment item in the module to be entered separately

Type: AO - Attendance only
- Cw - Coursework
- EX - Examination
- ICA - In-class Assignment
- PRA - Practical work
- PRE - Presentation
- IS - Independent Study, dissertation or project

Description – Text description of type of assessment. For example:
- Cw - Essay of 2,000 words
- EX - Open Book examination
- IS - Dissertation, 10,000 words

Percentage of Mark - Percentage weighting for each item of assessment

11. INDICATIVE READING - amongst some of the materials you may be required to consult are: (up to 15 titles with date of publication)

- **Burke, Rory:** Project Management - Planning and Control Techniques; John Wiley & Sons, England, 5th ed., 2013
- **Cleveland, David L.:** Project Management - Strategic Design and Implementation; McGraw-Hill, New York, 5th ed., 2006
- **Dinsmore, Paul C. (Editor):** The AMA Handbook of Project Management; McGraw-Hill / AMA, New York, 3rd ed., 2010
- **Gray, Clifford / Larson, Erik:** Project Management - the complete guide for every manager; McGraw-Hill, New York, 3rd rev. ed., 2002
- **Lock Dennis:** The Essentials of Project Management; Gower, 2014 (Paperback)
- **Meredith, Jack R/ Mantel, Samuel J.:** Project Management - A Managerial Approach (with CD-ROM); John Wiley & Sons, New York, 8th ed., 2012
- **Turner, Rodney:** Gower Handbook of Project Management; Gower, 5h ed., 2014
- **DIN-ISO, IPMA and PMI:** Up-to-date standards in Project Management

- Lecture Notes from Prof. Dr. Florian Dörrenberg

12. VERSION NUMBER: 1.0
7 Microprocessor Based Systems

<table>
<thead>
<tr>
<th>1. CODE</th>
<th>EEM4016</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. TITLE</td>
<td>Microprocessor Based Systems</td>
</tr>
<tr>
<td>3. PATHWAY</td>
<td>ET / MT</td>
</tr>
<tr>
<td>4. INSTRUCTOR</td>
<td>Prof. Dr.-Ing. Werner Krybus</td>
</tr>
<tr>
<td>5. CREDITS</td>
<td>ECTS 8 (15)</td>
</tr>
</tbody>
</table>

6. DESCRIPTION AND PURPOSE OF MODULE – studying this module involves the following:

To select and use appropriate microprocessor hardware and software to solve real-time embedded system monitoring and control design problems.

7. INDICATIVE SYLLABUS CONTENT – the topics you may encounter on this module include:

Basic principles of digital systems:
- Digital versus analogue electronics
- Digital logic, Logic families, functions and gates, Memory types

Microprocessor architectures:
- Comparison of 8,16,32 bit microprocessors, microcontrollers and RISC microprocessors
- Instruction sets, architecture, speed, cost, support chips, interrupt facilities
- Memory and peripheral devices

Software Development:
- Comparison of low and high level languages
- Use of C to program microprocessors/microcontrollers
- Code generation procedures, Structured programming techniques
- Creation of re-usable library functions.
- Software testing procedures
- Development of embedded microprocessor systems:
  - Design of a system to meet the technical requirements of a specified engineering problem
  - Incorporation of interrupts, parallel and serial interfaces, power control
  - Requirements analysis and specification

Hardware and software partitioning

Project planning and time tabling, cost analysis, documentation archiving procedures

Use of In Circuit Emulators and debugger tools

System testing techniques

Transducers and the interfacing of analogue and digital circuits:
- Overview of transducer types with emphasis on interfacing methods to microprocessor based systems
- Signal sampling, Analogue and digital signals
- Digital to analogue conversion, Analogue to digital conversion
- Performance specifications

Applications in the automobile industry.

Data communications:
- Alphanumeric codes and serial communications
- An overview of interface standards such as RS232C, USB, I2C.

8. LEARNING, TEACHING AND ASSESSMENT – this module is delivered and assessed in the following ways:

This module is split between formal lectures and laboratory-based practical work. Teaching will be based around handouts containing course material, and example programs. Assigned reading, tutorial and lectures will also be used to import knowledge.

ECTS workload:
- Lectures 30 hours
- Computer-based exercises 40 hours
- Discussion /review /tutorial 30 hours
- Coursework 2 x 30 hours
- Directed reading 30 hours
- Exam preparation 50 hours
- Total: 240 hours

9. Learning Outcomes and Assessment Criteria:

<table>
<thead>
<tr>
<th>LEARNING OUTCOMES – when you have successfully completed this module you will:</th>
<th>ASSESSMENT CRITERIA - to demonstrate that you will have achieved the learning outcome you will:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Have knowledge and understanding of the main concepts, interfaces and peripheral components associated with microprocessor based systems</td>
<td>1 Describe and discuss the main characteristics of microprocessor and microcontroller architectures. Describe the features and application of various peripheral modules and IO-Interfaces in a typical microcontroller.</td>
</tr>
<tr>
<td></td>
<td>Have knowledge and understanding of the development tools for microprocessor based systems</td>
</tr>
<tr>
<td>---</td>
<td>-----------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>3</td>
<td>Have skills in design and developing of software for embedded systems in 'C' have skills in testing microcontroller systems and using design tools such as Integrated Development Environments and In Circuit Emulators</td>
</tr>
<tr>
<td>4</td>
<td>Be able to design and implement microcontroller systems for - signal processing - simple control applications - intelligent systems</td>
</tr>
</tbody>
</table>

10: ASSESSMENT ITEMS – your achievement of the learning outcomes for this module will be tested as follows:

<table>
<thead>
<tr>
<th>Assessment type:</th>
<th>Combined form of examinations</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASSESSMENT ITEM NUMBER</td>
<td>1</td>
</tr>
<tr>
<td>Type</td>
<td>PRA: CW</td>
</tr>
<tr>
<td>Description</td>
<td>E.g.: a) Design and implementation exercise. Assessment will be based on quality of design, documentation and function or b) Analysis, design and implementation task. Assessment will be based on quality of analysis, design, documentation and function</td>
</tr>
<tr>
<td>Percent of mark</td>
<td>50</td>
</tr>
</tbody>
</table>

Each assessment item in the module to be entered separately

Type:  AO - Attendance only  
Cw - Coursework  
EX - Examination  
ICA - In-class Assignment  
PRA - Practical work  
PRE - Presentation  
IS - Independent Study, dissertation or project

Description – Text description of type of assessment. For example:  
Cw - Essay of 2,000 words  
EX - Open Book examination  
IS - Dissertation, 10,000 words

Percentage of Mark - Percentage weighting for each item of assessment

11. INDICATIVE READING - amongst some of the materials you may be required to consult are: (up to 15 titles with date of publication)

- Lecture notes W. Krybus, South-Westphalia University of Applied Sciences
- Programming and Customizing the AVR Microcontroller, Dhananjay V. Gadre, McGraw-Hill, 2001
- C Programming for Customizing the AVR Microcontroller, Warwick A. Smith, Elektor Publishing, 2009
- AVR Microcontroller and Embedded Systems, Muhammad Ali Mazidi et. al., Prentice Hall, 2010
- Make: AVR Programming: Learning to Write Software for Hardware, Elliot Williams, Maker Media, Inc, 2014
- Atmel Web Site: www.atmel.com

12. VERSION NUMBER: 1.0
8 Modelling and Simulation of Mechanical Systems

1. CODE EEM4018
2. TITLE Modelling and Simulation of Mechanical Systems
3. PATHWAY ME
4. INSTRUCTOR Prof. Dr.-Ing. Alfons Noe
5. CREDITS ECTS 8 (15)

6. DESCRIPTION AND PURPOSE OF MODULE – studying this module involves the following:

The student learns that thorough modelling of mechanical components and technical systems and combined numerical simulation methods, by commercialized software packages, have enabled, improved, accelerated virtual CAX-product design, functional analysis, manufacturing or fault analysis. Established results are available in automotive, aircraft, aerospace, semiconductors, robotics, tooling machines, trains, wind mills, and others.

First, the Finite Element Method (FEM) will be addressed, which allows to determine fields for displacements, strain and stress tensors as well as heat flux and temperature fields from mechanical and thermal loadings under static, dynamic and thermal load conditions. Nonlinearities from finite deformations, nonlinear material laws (plasticity, creep, rubber) and contact between parts will also be covered. Second, the dynamics of assembled multiple body sets connected by joints, springs and dampers as well as the associated Multi Body Simulation (MBS) will be treated. MBS provides full quantitative result sets of nonlinear kinematics as well as forces and torques.

7. INDICATIVE SYLLABUS CONTENT – the topics you may encounter on this module include:

Finite Element Method (FEM)
- Solid Mechanics (kinematic of deformation, strain and stress tensors, material laws (thermo-elasticity, plasticity, creep, visco-elasticity, rubber), contact mechanics
- Weak Formulation of thermo-mechanical systems (variational principals, Galerkin method, static, dynamic)
- Discretization (p-method vs. h-method, iso-parametric concept, element types, meshing techniques
- Numerical simulation (solving nonlinear equation systems, implicit and explicit integration methods)
- Application of a professional FEM-software to a small industry-like project

Multi Body Simulation (MBS)
- Kinematics (Degree of Freedom, rotations (Euler-, Byrant angles), constraints, loops, minimal coordinates)
- Kinetics (Newton Euler-Equations, Lagrange Equations of 1st, 2nd type, Differential Algebraic Equations)
- Assembly of MBS-systems, load application, analysis requests and visualization
- Numerical Integration methods and properties (stiffness, DAE-systems/-index, integrator features: BDF (esp. Gear’s method), corrector-predictor, Newton-Raphson-Method, simulation control)
- Application of a professional MBS-software to a small industry-like project

8. LEARNING, TEACHING AND ASSESSMENT – this module is delivered and assessed in the following ways:

This module is divided into formal lectures to outline the theoretical background, followed up by further assigned reading and working out small mathematical models a part of the assignment. One simple hand model shall be analyzed for characteristic features theoretically. Their behavior has to be simulated by tools like MS.Excel, Matlab or Maple. Based on acquired knowledge and experiences with small models the student shall work out a more complex industry-like assignment problem by using the available professional simulation software, where in general the selection out of a FEM- or MBS-project will be prescribed by the instructor. A supervised introduction to the software tool will be provided. For the assessment a report must be submitted, presented and defended. The course will close with a written examination covering the lecture contents and the assignment project.

ECTS workload:

<table>
<thead>
<tr>
<th>Activity</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures</td>
<td>50</td>
</tr>
<tr>
<td>Computer-based exercises</td>
<td>60</td>
</tr>
<tr>
<td>Discussion /review /tutorial</td>
<td>20</td>
</tr>
<tr>
<td>Coursework</td>
<td>50</td>
</tr>
<tr>
<td>Directed reading</td>
<td>20</td>
</tr>
<tr>
<td>Exam preparation</td>
<td>40</td>
</tr>
<tr>
<td><strong>Total No. Hours</strong></td>
<td><strong>240</strong></td>
</tr>
</tbody>
</table>

9. Learning Outcomes and Assessment Criteria:

<table>
<thead>
<tr>
<th>LEARNING OUTCOMES – when you have successfully completed this module you will:</th>
<th>ASSESSMENT CRITERIA - to demonstrate that you will have achieved the learning outcome you will:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 have knowledge and understanding of the theory of structural and dynamic mechanical components</td>
<td>1 be able to build simple classroom-level physical models and generate associated mathematical models</td>
</tr>
<tr>
<td>2 have knowledge and understanding on solving differential equations for mathematical models.</td>
<td>2 be able to solve differential equation analytically, if available, or by known numerical procedure by treating classroom systems (solution, simulation, analysis)</td>
</tr>
</tbody>
</table>
3. Be able to create a computational model in a complex a professional simulation software to run the solver and performing post-processing, be able to analyse and critically assess features extracted from numerical simulation software tool.

4. Be able to analyse and critically assess features extracted from numerical simulation software tool.

10: ASSESSMENT ITEMS – your achievement of the learning outcomes for this module will be tested as follows:

<table>
<thead>
<tr>
<th>Assessment type</th>
<th>Combined form of examinations</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASSESSMENT ITEM NUMBER</td>
<td>1</td>
</tr>
<tr>
<td>Type</td>
<td>PRA, CW, PRE</td>
</tr>
</tbody>
</table>
| Description | E.g.:
  a) Develop a small physical and related mathematical model (structural / dynamic), characterize formally, visualize by simulation.
  b) Build numerical model of a given complex, industry-level problem in professional FEM- or MBS-software, simulate, analyse, assess, recommend. Assessment based on report, presentation and defending. |
| Examination (written, 2 hours) |
| Percent of mark | 50 | 50 |

Each assessment item in the module to be entered separately

Type:  AO - Attendance only  
Cw - Coursework  
EX - Examination  
ICA - In-class Assignment  
PRA - Practical work  
PRE - Presentation  
IS - Independent Study, dissertation or project

Description – Text description of type of assessment. For example:

Cw - Essay of 2,000 words  
EX - Open Book examination  
IS - Dissertation, 10,000 words

Percentage of Mark - Percentage weighting for each item of assessment

11. INDICATIVE READING - amongst some of the materials you may be required to consult are: (up to 15 titles with date of publication)


12. VERSION NUMBER: 1.0
9 Signal Processing

1. CODE EEM4011
2. TITLE Signal Processing
3. PATHWAY ET
4. INSTRUCTOR Prof. Dr.-Ing. Ulf Witkowski
5. CREDITS ECTS 8 (15)

6. DESCRIPTION AND PURPOSE OF MODULE – studying this module involves the following:

The module is defined to impart a practical and theoretical knowledge of digital signal processing to the student. Students will learn to use and to apply techniques for designing continuous time filters as well as discrete time filters using DSP techniques. Thus, techniques for evaluation of transfer functions from both frequency domain specification and from knowledge of the continuous time prototype are introduced and developed. Techniques for evaluating the performance of discrete time systems in the time and frequency domain from knowledge of the system transfer function using both long hand and CAD techniques are developed. Techniques for designing and implementing recursive and non-recursive digital filters are taught. Fast Fourier Transform and its applications is introduced. Computer aided design packages for simulating, designing, and implementing discrete time filter architectures will be applied.

7. INDICATIVE SYLLABUS CONTENT – the topics you may encounter on this module include:

Approximation theory
Transfer functions, low pass, high pass, band pass, band stop and all pass filters
Analysis and simulation using PSpice

Analogue system implementation
- Filter network prototypes, low pass filters, frequency scaling, magnitude scaling
- Network transformation, from LP to HP, BP and BS
- Analysis and simulation using PSpice

Sampling theory
- Shannon’s sampling theorem
- Sub-Nyquist sampling
- Signal and network aliasing

Z Plane (digital) transfer function analysis
- Constraints in z plane transfer functions
- Recursive /non-recursive structures
- Evaluation of system performance
- From H(z) to the z plane transfer function using mathematical techniques
- CAD tools for constraints based transfer function design

Analysis and simulation using Matlab/Simulink and LabVIEW
State space analysis of discrete time networks
Application of state space techniques to discrete time networks
Evaluation of state variables of electrical systems and of other domains
Equivalence of state variables and z plane transfer function description

Digital signal processing hardware
- Computing architectures for signal processing
- Fixed and floating point DSP processors
- Reconfigurable hardware based on FPGAs
- A/D resolution, coefficient word length, instruction cycle speed, bench marks
- Generation of hardware specification from system requirements
- Filter implementation based on a hardware design flow

Recursive (IIR) discrete time structures
- Design of discrete time networks based on analogue prototypes. Bilinear transformation
- Impulse invariant transformation
- Recursive structure overflow modes. Intermediate node distortion. Regular and transposed structures.
- Relevance to fixed and floating point DSP hardware
- High order recursive structures
- Analysis, synthesis, design and simulation using Matlab/Simulink and LabVIEW

Non recursive (FIR) discrete time systems

FIR structure and characteristics.
- Design based on inverse Fourier transforms and inverse FFT
- Windows and their characteristics, Design of windows based structures
- Specialist FIR structures - Integrator, Differentiator, Hilbert Transform
- Use of CAD packages to design and evaluate the performance of FIR structures
- Analysis, synthesis, design and simulation using Matlab/Simulink and LabVIEW

FFT analysis
- Theory of DFT/FFT analysis
- Algorithms for FFT/inverse
- FFT/based algorithms

Development of measurement chains, laboratory tests
- Vibration testing, modal analysis
- Process monitoring in metal cutting
- Acoustic emission
- Noise emission
- Noise cancelling in audio signals

8. LEARNING, TEACHING AND ASSESSMENT – this module is delivered and assessed in the following ways:

Structured notes will be used containing the required theory, worked examples and relevant tutorial questions. The lectures will be supported by tutorials in which the students will have to solve problems using both long hand methods and by using the supporting signal processing software and hardware platforms. These problems will be taken from variety of engineering fields e.g. communications systems, control systems, instrumentation. Laboratory and tutorial sessions are used to compare theoretical analysis/simulation to the results obtained from the experiments on the hardware and also to gain practical experience in assessing signal characteristics by evaluating their statistical description.

Practical tests on how to define and set up measurement chains will be done in a laboratory. Students will have to define and set up particular task in signal processing in vibration control, modal analysis, evaluations and assessment of process data and feature extraction.

ECTS workload:

<table>
<thead>
<tr>
<th>Activity</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures</td>
<td>45</td>
</tr>
<tr>
<td>Computer based exercises</td>
<td>30</td>
</tr>
<tr>
<td>Discussion / review / tutorial</td>
<td>25</td>
</tr>
<tr>
<td>Coursework</td>
<td>60</td>
</tr>
<tr>
<td>Directed reading</td>
<td>30</td>
</tr>
<tr>
<td>Exam preparation</td>
<td>50</td>
</tr>
<tr>
<td>Total</td>
<td>240</td>
</tr>
</tbody>
</table>

9. Learning Outcomes and Assessment Criteria:

<table>
<thead>
<tr>
<th>LEARNING OUTCOMES – when you have successfully completed this module you will:</th>
<th>ASSESSMENT CRITERIA - to demonstrate that you will have achieved the learning outcome you will:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Have knowledge and understanding of the theory of signal processing, time</td>
<td>1 Be able to apply signal processing theory to practical situations</td>
</tr>
<tr>
<td>and frequency domain, analogue and digital signals</td>
<td></td>
</tr>
<tr>
<td>2 Have knowledge and understanding of the theory of filtering signals</td>
<td>2 Be able to apply to engineering scenarios and analyse performance through simulation</td>
</tr>
<tr>
<td>3 Be able to analyse and critically assess a system to apply signal</td>
<td>3 Be able to set up different engineering application simulations and critically assess</td>
</tr>
<tr>
<td>processing simulation</td>
<td>system performance to a variety of stimulations</td>
</tr>
<tr>
<td>4 Be able to develop measurement chains in practical application</td>
<td>4 Develop a systematic approach to data acquisition for signal processing</td>
</tr>
<tr>
<td>5 Have skills to apply data acquisition, analysis and visualisation tools</td>
<td>5 Design measurement and simulation systems for practical engineering applications</td>
</tr>
<tr>
<td>to relevant application areas</td>
<td></td>
</tr>
</tbody>
</table>

10: ASSESSMENT ITEMS – your achievement of the learning outcomes for this module will be tested as follows:

<table>
<thead>
<tr>
<th>Assessment type:</th>
<th>Combined form of examinations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>PRA: CW</td>
</tr>
<tr>
<td>Description</td>
<td>E.g.:</td>
</tr>
<tr>
<td></td>
<td>a) Develop measurement chain</td>
</tr>
<tr>
<td></td>
<td>to acquire process data.</td>
</tr>
<tr>
<td></td>
<td>Assessment based on quality</td>
</tr>
<tr>
<td></td>
<td>of design, analysis,</td>
</tr>
<tr>
<td></td>
<td>function and documentation,</td>
</tr>
<tr>
<td></td>
<td>or</td>
</tr>
<tr>
<td></td>
<td>b) Design of filters according</td>
</tr>
<tr>
<td></td>
<td>to a given specification,</td>
</tr>
<tr>
<td></td>
<td>simulation, implementation</td>
</tr>
<tr>
<td></td>
<td>and analysis</td>
</tr>
<tr>
<td>Percent of mark</td>
<td>50</td>
</tr>
</tbody>
</table>
Each assessment item in the module to be entered separately

Type:  AO - Attendance only  
   Cw - Coursework  
   EX - Examination  
   ICA - In-class Assignment  
   PRA - Practical work  
   PRE - Presentation  
   IS - Independent Study, dissertation or project

Description – Text description of type of assessment. For example:

Cw - Essay of 2,000 words  
EX - Open Book examination  
IS - Dissertation, 10,000 words

Percentage of Mark - Percentage weighting for each item of assessment

11. INDICATIVE READING - amongst some of the materials you may be required to consult are: (up to 15 titles with date of publication)

- Chi-Tsong Chen, System and Signal Analysis, Holt Rinehart and Winston, 1988
- Digital Signal Processing, a practical approach, Ifeachor & Jervis, Addison Wesley, 1993

12. VERSION NUMBER:  1.0
10 Systems Engineering

1. CODE EEM4011
2. TITLE Systems Engineering
3. PATHWAY ET / ME / MT
4. INSTRUCTOR Prof. Dr.-Ing. Andreas Schwung, Prof. Dr. rer.nat Stefan Schweizer
5. CREDITS ECTS 8 (15)

6. DESCRIPTION AND PURPOSE OF MODULE – studying this module involves the following:
This module aims to introduce students to the fundamental concepts and underlying principles of systems engineering, including systems thinking, as well as the design and management of a range of engineering systems, especially including mechanical and electronic systems. The systems will be studied from a product lifecycle management perspective to cover the all stages from product market research, design, manufacturing to after-sales service and product recycles.
The instruction will be supplemented with case studies and applying the knowledge in engineering simultaneously.

7. INDICATIVE SYLLABUS CONTENT – the topics you may encounter on this module include:
The module covers the area of product lifecycle management including introduction to system science and engineering, system requirement analysis and specification, system architecture design, system detail design and development, unit and system test, evaluation and validation. A special focus lies on the various ways of system modelling as a powerful tool to cover system engineering over the product lifecycle. Furthermore the importance of data engineering from early design phases till the end of the product lifecycle will be discussed.
The module enables the students to more effectively design solutions that meet customer needs by identifying and translating them into a complete set of requirements and specifications for a system.
The module emphasizes the distinction between an operational need and a system solution, and stresses the importance of understanding the customers need before jumping to a solution. The intent is not just to describe the systems engineering and architecting process but to understand the interrelation between different engineering disciplines and to stress the importance of an integrated system design. This is enabled by model and data based design techniques which enable the student to think in systems, rather than in disciplines.
The module helps students understand how to think through the choices at each step of the process. What decisions have to be made? What factors should be considered in making them? The answers to these questions allow for good systems engineering without adherence to standard processes. The primary objective of this module is to achieve a strong foundation in systems engineering principles and processes.

8. LEARNING, TEACHING AND ASSESSMENT – this module is delivered and assessed in the following ways:
This module is split between formal lectures and laboratory-based practical work. Teaching will be based around handouts containing course material, and example programs. Assigned reading, tutorial and lectures will also be used to import knowledge.

<table>
<thead>
<tr>
<th>ECTS workload:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures</td>
</tr>
<tr>
<td>Computer-based exercises</td>
</tr>
<tr>
<td>Discussion /review /tutorial</td>
</tr>
<tr>
<td>Coursework</td>
</tr>
<tr>
<td>Directed reading</td>
</tr>
<tr>
<td>Exam preparation</td>
</tr>
<tr>
<td>Total No Hours</td>
</tr>
</tbody>
</table>

9. Learning Outcomes and Assessment Criteria:
LEARNING OUTCOMES – when you have successfully completed this module you will:

<table>
<thead>
<tr>
<th>LEARNING OUTCOMES</th>
<th>ASSESSMENT CRITERIA - to demonstrate that you will have achieved the learning outcome you will:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Be able to critically review and apply the principles of systems engineering to the practical problems of product lifecycle management</td>
<td>1 - develop confidence in using systems concepts - understand systems engineering process models, methods and tools for the development of complex systems</td>
</tr>
<tr>
<td>2 Be able to develop knowledge and evaluate the system design requirements and validation.</td>
<td>2 explain the system development process, including requirements for systems reliability</td>
</tr>
<tr>
<td>3 Be able to understand procedures for developing physically based mathematical models of physical systems, and related analytical and numerical methods for predicting their behaviour.</td>
<td>3 - outline and discuss the process of systems modelling, where models are used as part of a systemic approach to various systems - derive and analyse mathematical models for real world examples</td>
</tr>
</tbody>
</table>
10: ASSESSMENT ITEMS – your achievement of the learning outcomes for this module will be tested as follows:

<table>
<thead>
<tr>
<th>Assessment type:</th>
<th>Combined form of examinations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ASSESSMENT ITEM NUMBER</strong></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td><strong>Type</strong></td>
<td><strong>CW</strong></td>
</tr>
<tr>
<td><strong>Description</strong></td>
<td>E.g.:</td>
</tr>
<tr>
<td></td>
<td>a) Analysis, design and implementation task. Assessment will be based on quality of solution, documentation and function or b): Lab exercises for modelling systems as group work, presentation and discussion</td>
</tr>
<tr>
<td><strong>Percent of mark</strong></td>
<td>50</td>
</tr>
</tbody>
</table>

Each assessment item in the module to be entered separately

- **AO** - Attendance only
- **Cw** - Coursework
- **EX** - Examination
- **ICA** - In-class Assignment
- **PRA** - Practical work
- **PRE** - Presentation
- **IS** - Independent Study, dissertation or project

Description – Text description of type of assessment. For example:

- **Cw** - Essay of 2,000 words
- **EX** - Open Book examination
- **IS** - Dissertation, 10,000 words

Percentage of Mark - Percentage weighting for each item of assessment

11. INDICATIVE READING - amongst some of the materials you may be required to consult are:

- Lecture notes, South-Westphalia University of Applied Sciences
- Systems Engineering, Principles and Practice, Kossiakoff et.al., John Wiley & Sons, 2011

12. VERSION NUMBER: 1.0
11 Technical Publications and Presentations

<table>
<thead>
<tr>
<th>1. CODE</th>
<th>EEM4014</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. TITLE</td>
<td>Technical Publications and Presentations</td>
</tr>
<tr>
<td>3. PATHWAY</td>
<td>ET / ME / MT</td>
</tr>
<tr>
<td>4. INSTRUCTOR</td>
<td>Marga Taylor</td>
</tr>
<tr>
<td>5. CREDITS</td>
<td>ECTS 7 (15)</td>
</tr>
</tbody>
</table>

6. DESCRIPTION AND PURPOSE OF MODULE – studying this module involves the following:

Enabling the student
- to plan, compose and present scientific publications
- to recognize, by logical analytical processes, subjects of scientific interest and potential
- to isolate and clearly define the central problem or idea being investigated
- to conduct an organized investigation of that specific topic
- to proceed with a systematic search and collection of information from all accessible relevant sources, as well as, after finding and sifting out the decisive facts
- and finally to organize them according to their importance for the logical development of the argument.

7. INDICATIVE SYLLABUS CONTENT – the topics you may encounter on this module include:

Preparing scientific and technical publications:
- Abstracts
- Papers

Presentations:
- Oral presentations
- Poster presentations

Information acquisition:
- Research in data-bases
- Electronic communication systems (e.g. WWW)

8. LEARNING, TEACHING AND ASSESSMENT – this module is delivered and assessed in the following ways:

The teaching is practice-oriented with supporting lectures in information acquisition. There is a strong emphasis on group-project work that is assessed through composition of abstracts and papers as well as oral presentation.

ECTS workload:

<table>
<thead>
<tr>
<th>Lectures:</th>
<th>45 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discussion / Review / Tutorial:</td>
<td>55 hours</td>
</tr>
<tr>
<td>Assignment preparation and completion:</td>
<td>2 x 40 hours</td>
</tr>
<tr>
<td>Directed reading:</td>
<td>30 hours</td>
</tr>
<tr>
<td>Total No Hours</td>
<td>210 hours</td>
</tr>
</tbody>
</table>

9. Learning Outcomes and Assessment Criteria:

<table>
<thead>
<tr>
<th>LEARNING OUTCOMES – when you have successfully completed this module you will:</th>
<th>ASSESSMENT CRITERIA - to demonstrate that you will have achieved the learning outcome you will:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Be able to prepare abstracts and papers intended for scientific and technical publications</td>
<td>1 Divide the central problem into specific problems or questions. Get thoughts down on paper in logical order. Evaluate and classify any findings according to the logical drift of the argument. Differentiate between the basic principles of different form of communication (description, analysis, summary etc.).</td>
</tr>
<tr>
<td>2 Be able to supply correct references to support assertions and to acknowledge ideas and material borrowed from other sources</td>
<td>2 Be able to construct a formal outline of a report that serves as a scientifically convincing frame for the arrangement of the collected data. Master the formal techniques and accepted standards of scientific publications. Be able to locate materials about a subject by a systematic, organized search of available sources. Be able to apply and use communication systems for information acquisition. Make use of the relevant library materials</td>
</tr>
</tbody>
</table>
Be able to elucidate and discuss papers in oral presentation

Formulate in adequate English both written and verbal presentations. Prepare presentations by employing suitable layout techniques. Prepare appropriate papers and presentations by defining, stating and illustrating the scientific significance of the investigation of the material to be discussed.

10: ASSESSMENT ITEMS – your achievement of the learning outcomes for this module will be tested as follows:

<table>
<thead>
<tr>
<th>ASSESSMENT ITEM NUMBER</th>
<th>Type</th>
<th>Assessment type: Project work</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CW/PRE</td>
<td>Description: Written assignment about a technical topic. Extent: ~4000 words and oral presentation using slides or Power Point. Duration: ~20 min.</td>
</tr>
</tbody>
</table>

Each assessment item in the module to be entered separately

Type: AO - Attendance only
Cw - Coursework
EX - Examination
ICA - In-class Assignment
PRA - Practical work
PRE - Presentation
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EX - Open Book examination
IS - Dissertation, 10,000 words

Percentage of Mark - Percentage weighting for each item of assessment

11. INDICATIVE READING - amongst some of the materials you may be required to consult are: (up to 15 titles with date of publication)
The Chicago Manual of Style, 13th ed. (University of Chicago, Chicago, 1982).

12. VERSION NUMBER: 1.0