Courses for Semester #1

Ident. No. (Code)		Course Name	Status	Note
MM11		Advanced Engineering Mathematics	Done	
MM12		Advanced programming	Done	
MM13		Industrial Mechatronics and Robotic Systems	Done	Krzysztof, Damian or Tariq (LSBU) , Revised by Nabil.
MM14		Mechatronics Systems Modeling and Simulation	Done	
Elect.#1*				

*see electives summary

MM: Master in Mechatronics
1: 1st Semester
1 to 4: Serial No. of Course in the Semester

Advanced Engineering Mathematics, FINAL

Identification number MM11	Workload	Credits	Semester	Frequency of offer	Duration
	180 h	6 ECTS 3 CH	1	Winter semester	1 Semester

1	**Courses** Course instruction: 2 HPW Exercise: 2 HPW	**Contact time** 4 HPW / 60 h	**Self-study** 120 h	**Planed group size** 20 students

2 Course Description

Build on the undergraduate students' math knowledge in order to provide the necessary skills in analytical and computational mathematical methods to work in a scientific environment and solve engineering problems in research and development projects.

3 Learning outcomes / competencies

On completing the course, students will be able to have to following skills:

- *Knowledge and understanding*

  A1. Understand analytical and computational principles in advanced mathematical methods.

  A2. Identify different transformations methods for the solution of advanced problems.

- *Intellectual skills*

  B1. Formulate strategies for solutions to advanced engineering problems based on the methods taught

  B2. Select mathematical tools appropriate for advanced engineering problems

- *Professional and practical skills*

  C1. Apply advanced mathematical methods for solving engineering problems.
  C2. Recognize the advantages / disadvantages of different computational solutions and select appropriate algorithms and software accordingly

- *General and transferrable skills*

  D1. Use a structured approach to advanced quantitative engineering problems.

  D2. Communicate solutions adequately

4 Contents

- *Analytical Methods: Real and complex analysis; Partial differential equations, Fourier Transforms; Laplace transforms; Difference equations; Z-Transforms; advanced matrix operations and manipulations*

Computational Methods: *Computer arithmetic; Numerical solutions of nonlinear equations and systems; Numerical solutions using least squares methods; Optimization theory.*

5 Teaching Method

Lectures, tutorials, problem solving, modeling, and self-studies.

6 Requirements

Bachelor degree (BSc, BEng) in Engineering

7	***Examination*** *Written in-class exams; Take-home exams*
8	***Requirements for awarding credit points*** *Module examination*
9	***Significance of the mark for the final score*** *70%*
10	***Representative module and full-time teachers*** *Name of module coordinator at offering institution*
11	***Other Information*** ***Books*** ▫ *K. A. Stroud, Advanced Engineering Mathematics, Industrial Press, 2011* ▫ *S. Chapra: Applied Numerical Methods with MATLAB, 3rd ed. McGraw Hill 2011.* ▫ *E. Kreyszig, Advanced Engineering Math, Wiley Publisher. 10th edition, 2010*

Advanced programming, FINAL

Identification number MM12	Workload	Credits	Semester	Frequency of offer	Duration
	180 h	6 ECTS 3 CH	1	Winter semester	1 Semester

1	Courses	Contact time	Self-study	Planed group size
	Course instruction: 2 HPW Exercise: 2 HPW	4 HPW / 60 h	120 h	20 students

2 Course Description

Motivate Students' knowledge of Object Oriented Concepts (OOP). Teaching the knowledge and skills needed to develop reusable, quality programs. Using OOP to design and implement complex and real-time systems and to increase their proficiency in programming using available software Packages.

3 Learning outcomes / competencies

On completing the course, students will e able to have to following skills:

- Knowledge and understanding

  A1. Tell the principles of Object Oriented paradigms (OOP).

  A2. Use of knowledge of OOP to design and implement complex and real-time systems.

- Intellectual skills

  B1. Formulate and model designs for solutions to advanced engineering problems based on the methods taught

  B2. Choose modeling and programming tools appropriate to solve complex systems.

- Professional and practical skills

  C1. Apply OOP methods in control and mechatronic systems. in engineering problems.
  C2. Create and model complex problems by using appropriate tools.

- General and transferrable skills

  D1. Get hand-on experience in OOP method of thinking.

  D2. Communicate solutions adequately

4 Contents

Analytical Methods: Object-Oriented Paradigm (Static, Dynamic). Parallel, Distributed Systems. Introduction to Database System.

Practical Methods: The use of OOP to analyze, design, and implement complex systems. Choose an application example to evaluate its performance. The use of Unified Modeling Language (UML) as a tool for designing and implementing the control and mechatronic systems. Application using available software (LABVIEW, MATLAB, or any OO-Language such as Java).

5 Teaching Method

Lectures, tutorials, problem solving, modeling, self-studies.

6 Requirements

Bachelor degree (BSc, BEng) in Electrical Engineering, Mechanical Engineering or Computer Science

7 Examination

	written examination
8	**Requirements for awarding credit points** Module examination
9	**Significance of the mark for the final score** **70%**
10	**Representative module and full-time teachers**
11	**Other Information** **Books** ▫ Beginning C# Object-Oriented Programming, Apress, 2011. ▫ Beginning Visual C# 2012 Programming, John Wiley & Sons, 2012. ▫ Real-Time Object Uniform Design Methodology with UML, Springer; 2007.

Industrial Mechatronics and Robotic Systems, Krzysztof, Tariq Sattar, revised by Nabil					
Identification number **MM13**	**Workload** 180 h	**Credits** 6 ECTS 3 CH	**Semester** 1	**Frequency of offer** Winter semester	**Duration** 1 Semester

1	**Courses** Course instruction: 2 HPW Exercise: 2 HPW	**Contact time** 4 HPW / 60 h	**Self-study** 120 h	**Planed group size** 20 students
2	**Course Description:** The main objectives of this course are to introduce: 1. The different automation systems used in modern industry and the use of robots in soft automation ones. 2. The fundamental transformation techniques from different frames of reference and kinematic analysis of robots. 3. Robot dynamics. 4. Machine vision.			
3	**Learning outcomes / competencies** On completing the course, students will be able to have to following skills: ▫ **Knowledge and understanding** A1. Classify the different industrial automation types. A2. Classify the different types of robots. A3. Derive the transformation matrices between different frames of references. A4. Formulate the forward and inverse kinematics problems. A5. Clarify the machine vision concepts. ▫ **Intellectual skills** B1. Analyze robots motion. B2. Use inverse kinematics to calculate the inputs for the actuators. B3. Design of the robots links considering the static and dynamic analysis. ▫ **Professional and practical skills** C1. Apply robot programming for robots to achieve a given task. . C2. Create robots models for design and analysis. C3. Apply machine vision technology for robot control. ▫ **General and transferrable skills** D1. Use information Technology for design and analysis. . D2. Communicate solutions adequately D3. Lifelong self-learning.			
4	**Contents:** Automation and robots- Robot classifications- Robot applications in Manufacturing - Performance specification and robot selection criteria - Fundamental theory and practical applications of robotic manipulators and mobile robots – Forward kinematics – Inverse kinematics- Work space analysis and trajectory planning -Equations of motion- Robot dynamics and statics - Motion planning - introduction to machine vision- basics of robot programming.).			
5	**Teaching Method** Lectures, tutorials, problem solving, modelling, self-studies.			
6	**Requirements**			

	Bachelor degree (BSc, BEng) in Electrical Engineering, Mechanical Engineering or Computer Science
7	**Examination** written examination
8	**Requirements for awarding credit points** Module examination
9	**Significance of the mark for the final score** 70%
10	**Representative module and full-time teachers**
11	**Other Information** **Books** ▫ John J. Craig; "Introduction to Robotics Mechanics and Control"; Pearson Prentice Hall, Latest edition. . ▫ Robert J. Schilling; " Fundamental of Robotics- Analysis & Control.

Mechatronics Systems Modeling and Simulation, FINAL

Identification number	Workload	Credits	Semester	Frequency of offer	Duration
MM14	180 h	6 ECTS 3CH	1	Winter semester	1 Semester

1	Courses	Contact time	Self-study	Planed group size
	Course instruction: 2 HPW Exercise: 2 HPW	4 hpw / 60 h	120 h	20 students

2 Course Description

This course covers three main areas: modelling, simulation, and identification. It presents several modelling methodologies that can be used for mechatronics systems. This will cover mathematical and graph models. Software tools, such as MATLAB/Simulink and/or LABVIEW, will be used to simulate the systems and analyze the responses. Also, an introduction to system identification will be provided

3 Learning outcomes) / competencies

On completing the course, students will acquire to following skills:

- Knowledge and understanding

  A1. Recognize modelling and identification concepts as related to mechatronics systems

  A2. Understand simulation tools and results' analysis
- Intellectual skills

  B1 Comprehend complex models

  B2. Recognize patterns among different systems
- Professional and practical skills

  C1. Simulate industrial systems using software packages

  C2. Identify dynamic physical systems
- General and transferrable skills

  D1. Apply modelling and simulation techniques to engineering system design

  D2. Optimize system performance

4 Contents

Modeling and Simulation Principles; System Analogies (mechanical, electrical, fluid and heat elements); Block Diagram Models and Transfer Functions; State Space Models; Model Linearization, Linear Graphs, Modeling of Electrical, Mechanical Systems, and Mechatronics Systems; System Response and Simulation, Model verification and validation; System Identification (parametric vs. nonparametric methods)

5 Teaching Method

Lectures, presentations and movies, discussions, tutorials, problem solving, projects, self study.

6 Requirements

Undergraduate courses in Control and engineering mathematics.

7 Examination

written examination

8	**Requirements for awarding credit points** Module examination
9	**Significance of the mark for the final score** 70%
10	**Representative module and full-time teachers** Name of module coordinator at the offering institution
11	**Other Information** Literature: ▫ Mechatronics: An integrated approach by Clarence de Silva 2005 ▫ Digital Control Systems: Design, Identification and Implementation by Landau and Zito 2006 ▫ System Identification: Theory for the user by Lennart Ljung. Prentice Hall 1999 ▫ Modeling Identification and Simulation of Dynamic Systems by PP van den bosch and AC van der Klauw. CRC Press. 1994 ▫ Modeling of Dynamic Systems by Lennart Ljung and Torkel Glad. Prentice Hall 1994 ▫ Identification of Dynamic Systems: An introduction with applications by Rolf Isermann and Marco Munchhof. Springer 2010