Technische Hochschule Ulm
University of Applied Sciences

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IEEP – INTERNATIONAL ELECTRICAL ENGINEERING PROGRAM

Technische Hochschule Ulm
University of Applied Sciences

IEEP - International Electrical Engineering Program

Student Exchange Program

Contents

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IEEP Courses Overview

It is necessary to coordinate the courses that students want to take, with the corresponding department at their home University. Courses can be either compulsory, elective or just optional.

IEEP Course	Credits
Digital Integrated Circuits	4
Control Technology	4
Advanced Project Work	4
Germany In The Last Three Centuries	4
German Language Courses	2 / 3 / 5

Attendance at the lectures is required.

Course Dates

You can find the course dates in our information leaflet **Semester dates – Spring**.

Exams

In case a student fails a course, i.e. is awarded a grade of 4.7 or worse, a re-examination may be done within 2 weeks after the announcement of the exam results. The examiner decides both the date and the form of the re-examination.
For conducting the re-examination the candidate has to be present in person. The exam may not be taken at the home university.

Digital Integrated Circuits

Department	Faculty „Electrical Engineering and Information Technology“
Catalog Description	This is an introductory course presenting the fundamentals of digital integrated circuit design. This includes the basics of VHDL as well as the fundamentals of programmable digital circuit technology such as FPGAs. Exercises are carried out on workstations with state-of-the-art design software and FPGA development boards.
Prerequisites	Basic knowledge of digital technology
Class Schedule	per week: 4 periods (45 min) + additional time (1 hour) to complete lab exercises
Textbook	Own manuscript (in English) will be provided
References	Brock J. LaMeres, Introduction to Logic Circuits & Logic Design with VHDL, Springer 2017 Volnei A. Pedroni, *Digital Electronics and Design with VHDL*, Morgan Kaufmann, 2008 Peter J. Ashenden, *The Designer's Guide to VHDL,* 3rd Edition Morgan Kaufmann, 2008
Credits	4

Relationship to Program Educational Objectives

1. The students receive a thorough introduction to the digital integrated circuit technology. They get insight in the potential and restrictions in view of the digital circuit design for programmable logic integration.
2. The students get acquainted with basic VHDL concepts. They describe the behaviour of digital circuits theoretically using their knowledge in digital technology and perform simulations.
3. The students consolidate their knowledge by design entry and circuit simulation with the latest industry standard software and digital hardware boards.
4. Hardware experiments in the laboratory is provided in order to give a feeling of the real world, which can be compared with the theory and the simulation results.

Course Learning Objectives

Students who receive credit will have demonstrated the ability to do the following tasks.

1. Work with state-of-the-art EDA tools (Xilinx ISE® Design Suite).
2. Design and analyse combinational and sequential circuits for a circuit integration.
3. Create, debug and simulate digital designs based on VHDL.
4. Configure FPGAs and verify hardware operation based on development Boards.
5. Understand the EDA design processes (including IP-Core based design) as they relate to the FPGA design flow steps.
6. Describe fundamental architectures of digital programmable circuits like standard FPGAs and advanced System On Chip FPGAs.
7. Design digital systems which use embedded clock processing sub-systems of the chip.
8. Optimise the synthesized circuit according to specifications of timing constraints.
9. Verify the function of a digital circuit using a post place & route timing simulation in combination with HW tests.

Topics

1. Fundamentals of Hardware Description Language (VHDL):
   Basic elements of VHDL code, operators, attributes, concurrent code, sequential code, structural description.
2. VHDL Design and Simulation:
   Design of combinational logic, design of sequential logic, hierarchical design, simulation of digital circuits, creating a test bench.
3. Programmable digital circuits:
   Digital circuit implementation approaches, fundamentals of programmable logic (SPLD,CPLD, FPGA), basic FPGA architectures, modern System on Chip FPGAs.
4. System- and High-Level Design Methodologies:
   Schematic entry vs. HDL entry, IP core based design, arithmetic circuits, clock management, use of embedded sub-systems, high level design based on Matlab/Simulink, aspects of HW/SW co-design.

Laboratory Exercises

1. Familiarization with the Xilinx ISE® Design Suite and the Virtex 5 FPGA development Board.
2. Design and Simulation of combinational logic and sequential logic.
3. FPGA-Implementation of a switch debouncer circuit including timing analysis, Pin-Assignment and programming of the Virtex 5 chip.
4. Use of embedded FPGA sub-systems to process different clock signals.
5. High-Level Design and simulation of a Direct Digital Synthesizer using the Core Generator of Xilinx ISE® Design Suite.

Control Technology

Department	Faculty „Electrical Engineering and Information Technology“
Catalog Description	This is an introductory course presenting the fundamentals of feedback control including description of Plants. Simulation techniques (Matlab/Simulink) are applied during the course.
Prerequisites	Basic knowledge of Laplace transform and differential equations
Class Schedule	per week: 4 periods (45 min) + additional time (1 hour) to complete lab exercises
Textbook	Own textbook (in English) is provided
Credits	4

Relationship to Program Educational Objectives

1. Students receive a short theoretical overview of mathematical system description as refreshment and based on existing knowledge (see prerequisites).

2. Theoretical system knowledge is expanded by more detailed and realistic applications, mainly addressing automotive industry problems.

3. Students learn the essentials of linear control theory. The stability problem is addressed. Theory is minimised by restriction to simple control loops with PI controllers and Bode plot with phase margin as design criterion.

4. Students assess their own learning success while applying the contents of the course at the end within a complete application example. They have to solve a complex control problem and run through the design steps
   - problem description,
   - definition of control goals,
   - plant description, plant simulation,
   - design of control architecture,
   - parameter calculation for the controller,
   - verification of the control loop performance.

Course Learning Objectives

Students who receive credit will have demonstrated the ability to do the following tasks.
1. Describe dynamical systems by differential equations
2. Visualise mathematical models as signal flow diagrams and design Matlab/Simulink models
3. Convert ODE description to transfer Functions
4. Select a linear controller and implement it as analogue or digital device
5. Design the control loop
6. Apply Nyquist criterion in order to ensure control loop stability
7. Calculate phase margin of open loop
8. Simulate and verify the design result

Topics

1. Introduction to the control problem, control loop performance assessment
2. System Theory and Plants
   - 2.1 Mathematical Models of Systems
   - 2.2 Frequency Features of Systems
   - 2.3 System graph and Simulation
   - 2.4 Selected Plants
3. Controller and Control Loop
   - 3.1 Controller Tasks
   - 3.2 Controller Architecture
   - 3.3 Controller Types and Implementation
   - 3.4 The Control Loop
   - 3.5 Stability of the Closed Loop
4. A Complete Application

Laboratory Exercises

1. Demo Exercises with different Plants in the Control Lab
2. Familiarisation with Matlab/Simulink
   Simulation of simple system's step response
3. Simulation of a DC drive
4. Drawing Bode Diagrams with Matlab
5. Simulation of a Spindle Drive Position Control Loop
6. (optional) Realization of a Turn Rate Control Loop with an Analogue Controller

Advanced Project Work

Department	Faculty „Electrical Engineering and Information Technology“
Catalog Description	This is an interdisciplinary engineering project including project planning, reporting and presentation
Prerequisites	Knowledge of electrical engineering basics
Class Schedule	per week: 6 periods, 45 min each (minimum)
Textbook	not applicable
Credits	4

Relationship to Program Educational Objectives and Course Learning Objectives

1. Students apply their electrical engineering knowledge with a “real life” or “Lab based” engineering problem.
2. Students learn to define such a problem and to describe it as first part of their project report.
3. Students learn to plan a project, i.e. to break down the problem description to working packages and to set up a project time table.
4. Students solve the technical problem. Applicable literature is to be evaluated and often a Web-investigation is to be performed.
5. Students provide a report about their project and give a presentation, using standard presentation techniques like PowerPoint.
6. An oral test gives the students the opportunity to maintain their project results.

Course Learning Objectives

Students who receive credit will have demonstrated the ability to do the following tasks.

1. Organize a project plan in cooperation with a project partner.
2. Make a literature or web investigation of the state-of-the-art technology.
3. Carry out a project according to a project plan.
4. Write intermediate reports and a final technical report.
5. Give a technical presentation in front of an auditorium.

Topics

The following general topics have to be fulfilled during the course

1. Problem description and analysis
2. Literature and/or Web investigation
3. Discussion of project features with supervisors
4. Realisation of the project in teamwork
5. Technical report
6. Technical presentation
7. Oral Test

Typical projects are:

- Analysis of a control problem, design of a control architecture
- Development of a sensor concept
- Simulation and design of microelectronic circuits
- Development of a computer-controlled test program
- Evaluation of system measurements

Laboratory Exercises

Not applicable

Students are welcome to stay at Ulm University of Applied Sciences for an additional month to work on a project in one of the university’s laboratories.

Germany In The Last Three Centuries

Department	Computer Science
Catalog Description	German history up to and including reformation and the Thirty Years War; culture, society, and political developments in the 18th century; reform and liberation; German federation; revolution in 1848; Bismarck and his struggle for Prussian hegemony; the German Empire & the 1st World War; the Weimar Republic; Nazi Germany & the 2nd World War; the aftermath of the wars; detente and German reunification
Prerequisites	None
Class/Lab Schedule	Four class periods per week
Textbook	Martin Kitchen: *Cambridge Illustrated History of Germany*, Cambridge University Press, Cambridge 1996
Other Materials	Numerous source materials (print, audio, video) in English or in English translation (to be distributed in class)
Credits	Liberal Studies: 4 credits

Relationship to Program Educational Objectives
Similar to other LS courses

Topics

1. An Overview of German history up to and including reformation and the Thirty Years War.
2. Culture, society, and political developments in the 18th century. The rise of Prussia. The impact of the French revolution.
3. Reform and liberation. German federation. German nationalism in the 19th century as expressed in music and literature.
4. Revolution in 1848. Bismarck and his struggle for Prussian hegemony.
5. The German Empire & the 1st World War. The foundation of the Reich. Bismarck's domestic policy. Colonial policy. The culture of the Wilhelmine Empire. Crises and naval building. The 1st World War.
6. The Weimar Republic. Foundation of the Republic. The Versailles Treaty. Crises & fulfillment. The collapse of the republic.
7. Nazi Germany & the 2nd World War. The pseudo-democratic establishment and consolidation of the Nazi state. Social life and economic policy. The 2nd World War. Concentration camps and the Holocaust. The collapse of Nazi Germany.

8. The aftermath of the wars. Germany under occupation. The Iron Curtain. The foundation of the Federal Republic and the German Democratic Republic. Integration in different systems of alliances.
9. Detente and German reunification. The economic miracle in West Germany. West Germany’s “east policy”. The collapse of East Germany. Reunification and consolidation.

Course Learning Objectives

Each student who receives credit for this course will have demonstrated the ability to do all of the tasks listed below:

1. Describe and explain the political developments in and around Germany for the period under discussion
2. Describe and explain the socio-cultural evolution in Germany for the period under discussion
3. Explain the development of the German political system
4. Explain attitudes and customs in present-day Germany from an historical viewpoint

German Language

Department	Institute for Foreign Languages and Management
Catalog Description	see below, German classes are mandatory for participants of the program
Textbook	Menschen: Deutsch als Fremdsprache - Kursbuch, Hueber-Verlag Menschen: Deutsch als Fremdsprache – Arbeitsbuch, Hueber-Verlag Supplementary material provided by course coordinator
Credits	2, 3 or 5 credits

Intensive Course in March (voluntary)

German Intensive Course	Lessons per week	Credits
Beginner Level 1 (A1.1)	30 (5 x 6 lessons, 2 weeks)	2
Ankommen in Deutschland, Language and Culture (Previous knowledge of A2 required)	30 (5 x 6 lessons, 1 week)	2

Language Courses during term

German as a Foreign Language	Lessons per week	Credits
Beginner Level 1 (A1.1)	8	2
Beginner Level 2 (A1.2)	4	3
Elementary Level 1 (A 2.1)	4	5
Elementary Level 1 (A 2.2)	4	5
Intermediate Level 1 (B1.1)	4	5
Intermediate Level 2 (B1.2)	4	5

Goals: The courses will provide competence in speaking, reading and writing German according to the respective level of the Common European Framework (CEFR).

Evaluation: Written exam (and course participation where applicable)

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