3TU. School for Technological Design STAN ACKERMANS INSTITUTE

TU/e Technische Universiteit Eindhoven

Department Electrical Engineering

Post-Master Technological Designer Program

Information and Communication Technology

Study Guide – Course Information

(Study guide, update: March 16th, 2009)

General information

The design of professional systems and innovative consumer products that communicate with their (global) environment (e.g. wireless and electro-optical communication) is extremely challenging. This leads to many new solutions, for example embedded software and monolithic integrated (opto) electronic circuits in the field of telecommunication, medical applications and consumer products.

A Technological Designer is being trained in detail in the latest design methods and how to apply these.

The ICT program focuses on the design of complex multi-disciplinary systems in the area of three important societal themes:

- Care and Cure
- The Connected World
- Smart and Sustainable Society.

The Connected World

For our first theme the TU/e Department of Electrical Engineering has chosen telecommunications, which are of great importance to our modern society. By means of this theme the faculty hopes to aim at design, realization and validation of a coherent broadband and narrowband communications technology. We are working on both wired and wireless technology. At this moment the expertise of the chairs is focused on two important areas: high data rate global and short-range communication; and ultra-low-power wireless communication links.

Care and Cure

The theme Care and Cure is concerned with the medical side of electrical engineering; that is patient-centered care with the focus on prevention, early diagnosis and aftercare, with the goal of making hospital intake less necessary. By means of this, the quality of care can improve, the patient can exercise more control over his own health and costs become lower. The focus is on perinatology, cardiovascular disorders, neural disorders, sport and lifestyle.

Smart and Sustainable Society

Our third theme, Smart and Sustainable Society, aims at designing, realizing and validating technologies to make possible electrical networks and electro physical devices for transporting and manipulating electrical energy in a flexible, controlled and sustainable way regarding efficiency of costs, power and materials. The focus lies on intelligent power networks, smart actuators, automotive applications and the reduction of pollution and waste."

Individual training program

For each candidate we define an individual training program, taking into account:

- The candidate's background, actual and future interest.
- The anticipated industrial project and
- The requirements of a TU/e supervisor.

General structure

The TU/e Post-Masters Stan Ackermans Institute Program SAI-ICT consists of mandatory, mandatory specialization and elective courses (mainly in the first year) are preparing a candidate towards the (industrial) design project (12 months full-time = 60 ECTS).

Homologation courses

In exceptional cases, a limited number of homologation courses can be offered.

Mandatory courses

All of the PDEng Trainees will follow courses on system level design, design methodology, protection of intellectual property, entrepreneurship, technical writing and editing, professional development, project based management, a.o.

In the first year of the program an industrial project is organized for a team of all freshmen, in which the integration of essential technical design skills is trained in practice.

Mandatory specialization courses

Two courses have to be chosen upon proposal by the TU/e coach/supervisor in relationship with a candidate's background, future interest, the requirements of the supervising TU/e Research Chair as well as the final (industrial) project. In case remaining courses (out of these offers) can prepare the candidate for her/his final project (a) course(s) can be chosen in the section "Elective Courses" (see below).

Elective courses

At least five (elective) courses (total at least 20 ECTS) will be proposed by the TU/e coach/supervisor to give the TOIO the required basic knowledge for the future (industrial) project. The courses can be chosen from regular M.Sc-courses offered in the TU/e Department Electrical Engineering, as well as courses from other Departments (or universities) or courses from other TU/e Stan Ackermans Institute post-masters Designer programs (for example Software Technology).

Design project

The (industrial) design project (12 months full-time) is individually assigned for the second year. A part-time startup of the project in the first year (preferably in the second half of the first study year) is possible. In the project the PDEng candidate realizes a prototype following a well-defined path from idea, specification, system level design, detailed design to realization, testing and validation. Documentation, a compact and business-oriented written report must be made of the project. The design must be publicly defended.

Next page is showing the template of the Training and Coaching Scheme.

TU/e Department Electrical Engineering, Stan Ackermans Institute, Post-Master's Designers' Program on Information and Communication Technology

Training and Coaching Scheme (template)

"Professional Doctorate in Engineering (PDEng)"

Name PDEng candidate:			
Phone numbers:			
TU/e contract (from – till):			
Coach TU/e / Research Chair:			
Industrial coach:			
Mandatory courses:			
Nr.	**TU/e ident. nr.**		
1.)	9K010	Technical Writing and Editing	3 ECTS
2.)	9K091	Professional Development	4 ECTS
3.)	9K100	Methods and Techniques for Design	4 ECTS
4.)	5Z045	ICT Design and Teamwork "from idea to prototype" (in combination 9K091)	8 ECTS
5.)	5Z050	Design Methods for ICT-Systems (in combination with 9K091)	3 ECTS
6.)	TU/e	TU/e Workshop Scientific Integrity (0.5 day)	0 ECTS
7.)	TU/e	TU/e Workshop Technology Entrepreneurship (0.5 day)	0 ECTS
8.)	TU/e	TU/e Workshop Intellectual Property and Valorization (1 day)	0 ECTS
Mandatory specialization courses SAI-ICT: *Two courses (to be numbered 9. and 10.) out of the following list (a – j) are proposed by the TU/e coach/supervisor. He considers candidates' background, future interest, the requirements of the supervising TU/e Research Chair and requirements for the intended final (industrial) project. One or two remaining courses can be selected as "Elective Courses" (see below).*			
a)	5Z028	Specification of Complex Hardware/Software Systems	5 ECTS
b)	5Z032	Processor Design	4 ECTS
c)	5Z033	Advanced Computer Architecture	4 ECTS
d)	5Z034	Microstrip Antenna Analysis, Design and Verification	4 ECTS
e)	5N290 (5Z010)	Design of Digital Signal Processing Systems (Block A + B)	4 ECTS
f)	5P050	Capita Selecta in Electronics	4 ECTS
g)	5P630	Special topics in power electronics	4 ECTS
h)	5TT00	Optical Communication Networks	3 ECTS
i)	TNO Telecom, Delft	IMS – platform for IP-based applications in UMTS	4 ECTS
j)	TNO Telecom, Delft	UML – practice what you (pr/t)each	4 ECTS
Elective courses: *The total amount of credit points for elective courses should be (at least) **20 ECTS** (1 ECTS = 28 h workload in average).* *At least five (elective) courses (numbers 11 – 15), to be proposed by the TU/e coach/supervisor, to provide the PDEng candidate the required basic knowledge for the future (industrial) project. The courses can be chosen from regular M.Sc-courses offered in the TU/e Department Electrical Engineering, as well as courses from other Departments (or universities), courses from other TU/e Stan Ackermans Institute Designers' post-masters Designer programs (for example Software Technology). Furthermore, one or two remaining courses from the list of offered specialization course (a – j) can be chosen.*			
11.)			
12.)			
13.)			
14.)			
15.)			
In case the preparation of the candidate for the final project requires a literature study, case study, or other (internal or external) assessments additional ECTS can be awarded in section "Elective courses".			
Final project:			
16.)	9K110, mandatory	Project Based Management	2 ECTS
17.)	TU/e, mandatory	Preparation for final project (supported by Research Chair)	0 ECTS
18.)	5Z500, mandatory	Final project (in average 12 months full-time)	60 ECTS
Enrichment courses:			
	TU/e CeMAS	Courses like: LaTeX, C++, Unix/Linux (on candidates' request)	0 ECTS
	TU/e STU	Dutch Course incl. examination (on candidates' request)	0 ECTS
	TU/e STU	Applying for a job (on candidates' request)	0 ECTS

http://owinfo.tue.nl/ - general information about courses offered by TU/e

http://wwwooti.win.tue.nl/ - TU/e SAI Designer's Program Software Technology

http://www.win.tue.nl/cemas/en/ictcursussen.html - TU/e Centre for Mathematical Applications and Software

Course information

Remark: 1 ECTS = 28 h workload in average

Mandatory courses

9K010 Technical Writing and Editing 3 ECTS

Goals

The Technical Writing and Editing course is designed to help you communicate more clearly:

- to become more familiar with the concepts of technical writing and editing;
- to become more comfortable with planning, organizing, and producing a variety of texts;
- to polish your writing skills so the final product is of the highest quality in both content and composition.

Approach

Many intelligent, capable people believe that writing well is a form of magic; the whole idea of writing makes them uncomfortable, because in their earlier education 'writing' meant making mistakes and being corrected, while the keys to good writing remained hidden. This course is not about correcting mistakes (although you will certainly do so); it focuses on identifying and using those hidden keys. Writing clear, coherent texts requires a set of learnable skills; it is neither a matter of `correct' language nor purely a matter of talent. This course provides an explanation of the skills that can make you a better writer and provides guided practice in those skills.

The workshop format of the course allows ample opportunity for interaction between the professor and students as well as interaction among students from a variety of faculties. Each workshop includes a non-technical explanation of the theoretical basis for the day's work, including in-class exercises (generally incorporating both individual and co-operative writing) and a mediated discussion of the exercises.

Homework places the exercise and discussion in a larger context and provides additional practice. The main product of the course gives you an opportunity to write and edit a text in your area of interest,

directly related to your work, and directed toward a real audience. For example, designers might produce a formal managerial report, or progress report, while researchers might produce an article that is suitable for a conference presentation or publication in a professional journal.

Course structure

The course has three parts: two block weeks of class meetings and a hiatus between them. You will need to devote a significant amount of time to coursework during this hiatus and after each class meeting (especially in the final week).

During the first week of the course, there is intensive work to provide the necessary foundation for writing a technical article or report. Topics covered during this prewriting phase include increasing the readability of texts, analyzing audiences, planning and organizing texts, and utilizing forms of argument to structure texts.

During the hiatus between the two weeks of the course, you write your text. In the second week, the focus changes from one of producing a text to one of editing a text, which has been written.

The final week is the most intensive. It is devoted to editing strategies: first for considering and editing overall structure and the relationships between sections of a paper; then for strengthening the coherence of paragraphs and sentences; and finally for considering effective word-level changes, layout, and style. You will work with your own papers and those of your peers

to analyze where you have successfully incorporated the principles discussed during the first week and to edit those parts where there are still weaknesses.

Assessment

The instructor provides a pass/incomplete/fail grade and comments on the paper's structure, coherence and conformity to professional standards. In addition, a referee in your field (i.e., a professor or project leader) will comment on the paper's technical soundness.
The Technical Writing and Editing course will help you express your ideas more clearly in English. An added benefit is that most of what you learn is directly applicable to Dutch and other languages.

Information: Ms. G. Dekkers - Burke, HAL 1.29, e-mail: G.A. Dekkers-Burke@tue.nl

9K091 Professional Development ICT 4 ECTS

Coordinator: drs. Chris Sepers (STU)

Professional Development (PD) is spread across two years and concentrates on the non-technical skills expected of a designer in industry.

Objective:

- stimulation of the attitude in which you regard professional development as something you can control yourself;
- Development of your social, communication skills.

Approach:

- After an introductory meeting, in which you will receive information about the objective and work method of Professional Development, you will participate in the Self-Assessment Workshop (a two-day workshop held in a private conference hall).
- In addition to this workshop and taking your career in consideration, it leads to a Personal Development Plan, which allows you to map your own educational needs and goals for the next two years. In an individual meeting with your supervisor and facilitator you specify these learning goals.
- Pursuing these goals, you participate in regular meetings of the so-called study group. Each study group has its own supervisor (facilitator), who makes sure people follow their learning goals and who helps you to work on your learning points while monitoring the progress made in the aforementioned skills. A study group consists of designers of different study-programs; it emphasizes the interdisciplinary character of the study and your role in projects and work.

Information: Drs. H.C. Sepers, HG 0.62, tel. 4512, E-mail: H.C.Sepers@tue.nl

9K100 Methods and Techniques for Design 4 ECTS

Lecturer: dr.ir. K. van Overveld

Designing technological artifacts requires much more than just the technological knowledge that explains how the artifact functions. Designing starts with understanding who the customers are, what they wish, and what the contextual factors are. Next, in innovative design, there is a creative phase where solutions and alternatives are generated. These phases sometimes have to be iterated over repeatedly. Only in the last phase, definitive decisions are being made that shape the details of the artifact. In the course “Methods and Techniques for Design”, a number of techniques for the systematic exploration of context, requirements and solution space are taught. A balance is sought between, on the one hand, clean and structured thinking, and on the other

hand unorthodox and creative exploration. The techniques are applied to a more or less realistic design case.

Part I: Principles of design

- distinction between design and research;
- the roles of stakeholders and their intentions (*);
- decisions (type and impact on the design process) and reflection;
- representing the artifact-to-be-designed (ATBD) in terms of concepts and attributes;
- a model of the design process in terms of: -introducing concepts, -defining their attributes, and -assigning values to the attributes;
- a connection to object orientation (OO/UML) (*)

Part II: Creativity

- some basic principles from neurology and learning theory; the role of patterns in thinking; the role of patterns, and the necessity of escaping from patterns;
- structured techniques
  - ✓ using attributes to classify and partition the design space
  - ✓ hierarchy as a structuring device
  - ✓ orthogonality as a device for structuring and option generation
- non-structured techniques
  - ✓ random stimuli
  - ✓ multiple interpretation
  - ✓ inversion
  - ✓ linguistic techniques

Part III: Developing quantitative models on behalf of design

- attributes as variables; types and (sets of) values of variables in a model
- dependencies between variables; a classification of variables in dependence of their role in a model
- building quantitative and semi-quantitative models
- systematic incremental implementation of a model (either in EXCEL or ACCEL)
- optimization, Pareto-genetic optimization, and sensitivity analysis
- models and decision making

Lecture notes and other reference material complement courses and exercises.

In a crash-course format during 2 days, the main principles of parts I and II are reviewed. A few plenary exercises help to practice with the techniques from part II. Next, appointments are made with the

participants, on a per-group basis, to assist them (by means of consultation sessions) in applying the techniques from MTD in *their own* design projects. These projects are typically scheduled on a part-time basis over a full year, so consultation sessions can be evenly distributed in accordance with the agendas of both the participants and the teacher. As a deliverable, an additional appendix to the project report is required, which focuses on the application of the MTD-techniques in the design at hand.

5Z045 ICT Design and Teamwork (in combination 9K091) 8 ECTS

Lecturers/supervisors: dr.ing. P.H.A. van der Putten (E), drs. H.C. Sepers (STU).

Type of education: Team project (typically: 6 members, 6 month)

Course material:

Handouts will be provided at start of project: BCaM (Business Creation and Management) design flow, Project assignment.

Learning objectives:

ICT Design & Teamwork aims at developing a strong ICT design competence. A team develops an ICT based system/product for a real industrial customer in a six month project. The project is managed by the team itself following a real industrial design flow, with deliverables per milestone. The team is supervised in collaboration between industry and university. Guidance on working as a team is given as part of the Professional Development program.

Contents:

- The project encompasses design, test, realization and documentation, preferably of heterogeneous embedded systems (Hardware / processors / SoC's; Software; User interfaces; communication channels; Actuators/sensors);
- The project basis is a contract with an industrial partner, that defines: duration, budget and deliverables;
- The design methodology and work flow of the industrial partner is adopted and adjusted according to the joint goal of the project;
- Project management is the responsibility of the team itself, in close cooperation with the industrial and academic supervisors; the team proposes its own team leaders.
- The industrial principal is the stakeholder that determines tangible deliverables what system and documentation should be realized by the team. He also brings in cost awareness and assessment of industrial relevance.
- The university determines learning goals, and (additional) requirements concerning documentation such as reflection reports team performance as well as individual performance.
- The team is self-organizing, appoints a member as team leader per phase, organizes meetings, and draws up professional minutes; Team processes are monitored and improved under supervision of a professional coach in the context of SAI's Professional Development program.
- Deadlines for deliverables are specified in a continuing planning process.
- The team follows design steps according to the design flow adopted by the industrial partner, and delivers as a minimum the following documents:
  - ✓ Planning (ongoing updates)
  - ✓ Business plan
  - ✓ System specification
  - ✓ Test specification
  - ✓ System level design report
  - ✓ Detailed design report
  - ✓ Test rapport – Test manual
  - ✓ User manual
  - ✓ Design process report – Reflection report (team and individual)
- The project ends with a presentation and demonstration of a prototype, the transition of the prototype to the industrial principal and the transition of all documentation to both university and industrial partner.

Grading:

The grading process encompasses peer reviews, team grading and individual examination (also on subjects beyond the individual's contribution) by the joint supervisors.

5Z050 Design methods for ICT systems (in combination 9K091) 3 ECTS

Lecturers/supervisors: dr. ing. P.H.A. van der Putten (E), drs. H.C. Sepers (STU).

Organizer: Department of Electrical Engineering, Electronic Systems (E-ES) and the Students Service Centre (STU).

Rationale: The design of complex ICT systems is supported by a wide variety of design methods. Students acquire expertise and skills on particular design methods and modeling methods related to the projects they do. Examples of design fields that differ substantially are for example the design of hardware, software, opto-electronic systems, wireless networks, mechatronic systems, bio-medical systems, and etceteras. In each of these fields are many specialisms and types of design methods for various levels of abstraction. The design of complex systems requires co-operation of many designers. Therefore designers need a relatively broad understanding of design methods and models. The course 'Design methods for ICT systems' aims at sharing knowledge and expertise among all designers in the SAI-ICT program. Sharing knowledge is an important issue in knowledge-based industry. The course offers experiencing professional sharing of knowledge.

Description: All participants prepare and give at least one presentation about design methods used in their different final projects. Each monthly session is organized by a participant that has the role of chairman in that session. A session consists of a presentation, a discussion on a selected design topic, and an evaluation. All participants prepare their role in the discussion by studying a paper selected by the lecturer.

In the evaluation all participants get feedback on their role and their performance. All participants contribute to the evaluation, based on an assignment to observe particular aspects of the session. A professional on communication skills from the Student Service Center supervises the evaluation.
In the week before the session all participants must study an overview article that is sent to them by the chairman of the session.

Examination: A positive result requires attendance of a minimum of 15 sessions. Furthermore, at least one approved English presentation on design must be given. The presentation material must have been developed timely in close consultation with the supervisor and based on a pre-selected representative paper. All participants organize at least one session, where they must adequately perform in the role of chairman. Each participant should play an active role. At the end of the sequence one is expected to act in a group at a professional level. A lack of professional performance can lead to an additional assignment in the framework of professional development.

Information:
On contents: dr. ing. P.H.A. van der Putten, tel. 4267 (P.H.A.v.d.putten@tue.nl).
Professional development: drs. H.C. Sepers, HG 1.63, tel. 4512/8015 (H.C.sepers@tue.nl).
On organization: Mrs. H.W.J. van Gaalen, EH 9.24, tel. 3653 (H.W.J.v.Gaalen@tue.nl).

Course form: 20 sessions of 2 hours (presentation + discussion + evaluation), *Required skills:* M.Sc. electrical engineering or a related discipline. *Schedule:* Monthly sessions in accordance with participants and supervisors.

Study material: Selected papers are mailed a week before each session.

9K110 Project Based Management 2 ECTS

Description:

This course is specially designed for PDEng candidates to help them to set up, control and fulfill their final assignment. Not everything that is called a 'project' is a project. Still, projects are a common way of working. This means that a systematic way of thinking and structuring the project will increase the chances of its success.

- You will gain insight into the essential aspects of using a project approach (defining a result, determining the phases, decision making, controlling, risk analysis, work breakdown structure, organizational aspects) and into aspects that influence cooperation between people working in projects.
- You will develop skills to practice these aspects in your daily environment.
- You will have experienced the use of a project approach in your final assignment.
- You will have gained insight into the effectiveness of the method and in the conditions under which it can be applied.
- As a result of this training you will have a highly effective tool (methodology as well as practical experience) for managing your assignments, for communicating about your results and last but not least for advising (be a consultant to) your assigning organization.

It is important that Project Management is applied to real life projects. Therefore this course should be followed at the beginning of the final project assignment.

Participants: Minimum 12, maximum 16
Duration: One and a half consecutive days + 3 half day meetings during your project.
Throughput time: 3 till 6 months.

Workshop "TU/e, Intellectual Property and Valorization"

Organizer/lecturers: TU/e Innovation Lab, LICENTEC

Introduction

Companies have become increasingly interested in collaborating with universities and research institutes in their search for new technologies and products. The process of technology transfer is complex and it is important that both parties (the company and the university/research institute) benefit from such collaboration. It is therefore essential that universities and research institutes possess the tools necessary to secure and establish intellectual property rights in order to negotiate successful deals.
On this theme Licentec will coach TOIO students during a one-day workshop entitled "TU/e, Intellectual Property and Valorisation". Intellectual property rights, patent strategies and legal/licensing issues will be integrated on a 'need to know' basis.

Scope and Purpose

The three main goals of the workshop will be to:

- create awareness of the policy and means of support by TU/e and Innovation Lab;
- increase knowledge of elementary aspects of searching in patent databases, dealing with different options and making choices in establishing patent rights and commercializing these in the context of research and development co operations, and;
- teach elementary legal aspects regarding the licensing and technology transfer process such as the use of NDAs, issues on authorization and drafting contracts.

This one-day interactive workshop is intended for (max.) 20 TOIO participants. Emphasis is put on teaching the participants practical skills through interactive sessions and various exercises.

Mandatory specialization courses

Two courses have to be chosen out of offers (especially designed for this program) upon proposal by the TU/e coach/supervisor in relationship with candidate's background, future interest, the requirements of the supervising TU/e Research Chair as well as the final (industrial) project. In case remaining courses (out of these 10 offers) can prepare the candidate for her/his final project (a) course(s) can be chosen in the section "electives".

5Z028 Specification of complex hardware/software systems 5 ECTS

Lecturer: dr. ing. P.H.A. van der Putten

The aim of this course is to provide skills for system level design of complex hardware/software systems. The trend that products and systems become communicating systems with many parallel activities on multiple embedded processors and with complex multimedia interfaces makes their design unmanageable with the current hardware/software co-design practice. This workshop presents a system level design approach that yields executable system level models based on object-oriented analysis and specification. A design process starts with a multidisciplinary discussion enabled by formal models that visualize collaborating processes of a system and its environment. These models show functional real-time behavior as well as system architecture. Subsequently a model is extended with the properties of candidate implementation technologies. This enables verification and validation of required system properties. Dedicated models can be used for architecture studies on performance, channel bandwidths and real-time properties.

Target group: Participants of the programs Information and Communication Technology, and Mathematics for Industry. Participants from other PDEng programs are also welcome.

Course form: 4 days; lectures in the morning and in the afternoon mainly practical exercises that yield specification documents as well as working computer simulations. At the end of the course couples of participants get an assignment with a net workload of two weeks. This comprises the creation of a system specification and a simulation model.

Examination: A written report, a demonstration of a working simulation and an individual questioning of one hour. The report and simulation model must be handed in one week before the examination appointment.

Required skills: basic knowledge and skills on hardware and software design.

Schedule: To be planned in accordance with participants, usually first week of July, immediately after examination period of the University.

Study material: A reader with sheets, specification standards, language and tool manual, and simulation software.

Contents: Introduction co-specification; System engineering methodology; Object class modeling + exercise; SHESIM tool demo and exploration; Architecture modeling and design + exercise Structure Diagrams; Communication + exercise on Message Flow Diagrams; Scenarios and real-time; Parallel Object-oriented Specification Language + exercise Behavior Description; Modeling and simulation of various examples. [Specification notations in concordance with UML™ (Rational Software Corp.)].

Information:
On contents:
dr.ing. P.H.A. van der Putten, EH 9.29, tel.4267, E-mail: P.H.A.v.d.Putten@tue.nl
On organization:
Mrs. H.W.J. van Gaalen, EH 9.24, tel.3653, E-mail: H.W.J.v.Gaalen@tue.nl

5Z032 Processor Design 4 ECTS

Lecturers: Prof.dr. H. Corporaal / prof.dr.ir. R.H.J.M. Otten

Description: The course treats both the architecture and implementation of current RISC type of processors. RISC processors have a reduced instruction-set which enables the pipelined execution of instructions. This gives them a very high instruction throughput and performance, while their implementation is not too complex. RISC processors are used everywhere, not only in general purpose processors (although a Pentium is not a RISC its core also obeys the RISC design principles), but also in billions of embedded systems.
This course does not only deals with how to design these processors, but it also gives detailed information about the required memory hierarchy, interfacing, input and output peripherals, and the role of the operating system. In total this gives a thorough understanding of a complete processor system.
Part of the course consists of laboratory assignments, where students have to exercise assembly level programming and implement (parts of) a RISC processor in SystemC. The implementation has to be verified with real programs. The MIPS architecture is used as guiding example throughout the course.

Aim: The objectives of this course are: 1) to learn the design principles of different processor architectures, and how they act as target for a compiler (for languages like C); 2) to get a detailed understanding of RISC design principles; 3) learn how to program RISC type of processors; 4) learn different implementations of the same architecture; 5) be able to realize an implementation (at register transfer / signal level) using an HDL (hardware description language); 6) know how a processor fits together with the memory hierarchy, interfaces and operating system, to form a complete processor system, and 7) being able to analyze the performance of a processor system.

Basic knowledge: Basic knowledge of digital design and C (or C^{++}) programming is assumed to be present. A summary on digital design is available for students lacking specific knowledge.

Form of education: Nine lectures, accompanied with three laboratory exercises. These exercises can be made at home.

Form of examination: A (written) examination at the end, together with reports on laboratory exercises.

Schedule: Nine lectures.

Study material: Book: Patterson and Hennessy: Computer Organization (2nd ed.); Slides; SystemC user manual.

Furthermore, we will use the SystemC simulator, the SPIM simulator (for MIPS programs), and LCC compiler and assembler.

Contents: Performance indicators, Machine language, Implementation of arithmetic units, Processor data path and control, Specification and simulation using SystemC (this may include a small tutorial on C^{++} programming), Pipelining, Dealing with hazards and exceptions, Processor tuning and optimization, Memory hierarchy, Interfacing, and basic principles of Operating Systems.

Information: Mrs. H.W.J. van Gaalen, EH 9.24, tel. 3653; E-mail: H.W.J.v.Gaalen@tue.nl

5Z033 Computer Architecture 4 ECTS

Lecturers: Prof.dr. H. Corporaal / Prof.dr.ir. R.H.J.M. Otten / Dr.ir. L. Józwiak

Description: Studying the architecture, organization and use of the newest (micro)processors currently on the market, and the latest research developments in computer architecture. Architectures exploiting instruction-level parallelism (ILP) and task-level parallelism are treated. Starting from basic concepts we will end with discussing the latest processors on the market (e.g., Pentium 4, EPIC processors like Itanium, and embedded processors such as the TriMedia). This course also treats how processors can be combined in a multiprocessing platform, e.g. by using a Network-on-Chip. Interprocessor communication issues will be dealt with. Furthermore new code generation techniques needed for exploiting ILP will be dealt with. Special emphasis will be on quantifying design decisions in terms of performance and cost.

Part of the course will be project based. In this project the students will implement and realize an advanced processor network, using SystemC as implementation language and FPGA as realization target technology.

Aim: The intention of the course is to give students the ability to understand the design principles and operation of new (multi-)processor architectures, and evaluate them both qualitatively and quantitatively. Although we treat several examples, the emphasis will be on architecture concepts.

Furthermore, the aim is to design, implement and test a Network-on-Chip, by one or more student teams.

Basic knowledge: a basic knowledge of processor architectures, high level programming languages and operating systems is assumed to be present.

Form of education: Lectures (six sessions of three hours). Part of the course will be project based. In this project the students will implement and realize an advanced processor network, using SystemC as implementation language and FPGA as a realization target technology. Students will work in a group of 3 or 4 people to perform this project. At the end each student has to write an individual report about the final (third) lab assignment and prepare a short presentation. The results of the first two lab assignments have to be demonstrated per group (a date will be determined for that).

Form of examination: Oral examination based upon 1) discussed material and book, 2) the project results, and 3) a short presentation (about the project).

Schedule: 1st semester (block B & C).

Study material: book of Hennessy and Patterson: Computer Architecture, a quantitative approach (3rd ed.); Morgan Kaufmann Publishers, ISBN 1-55860-724-2 or 1-55860-596-7.

Lecture notes; SystemC user manual. Furthermore, we use the LCC compiler and assembler, and mapping tools for FPGA board.

Subjects: Basic principles (like instruction set design), pipelining and its consequences; VLIW (very long instruction word) architectures, Superpipelined, Superscalar, SIMD (single instruction, multiple data, used in vector and sub-wordparallel processors) and MIMD (multiple instruction, multiple data) architectures; Embedded architectures; Out-of-order and speculative execution; Branch prediction; Data (value) prediction; Design of advanced memory hierarchies; Multi-threading; Exploiting task-level and instruction-level parallelism; Input and output; Network Communication Architecture; and Networks-on-Chip.

Studying the architecture, organization and use of the newest (micro)processors currently on the market, and the latest research developments in computer architecture. Architectures exploiting instruction-level parallelism (ILP) and task-level parallelism are treated.

Starting from basic concepts we will end with discussing the latest processors on the market (e.g., Pentim 4, EPIC processors like Itanium, and embedded processors such as the TriMedia);

this course also treats how processors can be combined in a multiprocessing platform, e.g. by using a Network-on-Chip. Interprocessor communication issues will be dealt with. Furthermore, new code generation techniques needed for exploiting ILP will be dealt with. Special emphasis will be on quantifying design decisions in terms of performance and cost.

Information: Mrs. H.W.J. van Gaalen, EH 9.24, tel. 3653; E-mail: H.W.J.v.Gaalen@tue.nl

5Z034 Microstrip Antenna Analysis, Design and Verification - Traineeship 4 ECTS

Lecturer: Ir. H. Visser (EH 13.28, Tel: -3462, h.j.visser@tue.nl)

Description: The traineeship aims at gaining the student a deep insight into all aspects of designing, realizing and characterizing antennas. The student will gain insight in analytical models, the use of antenna simulation tools, handling a vector network analyzer and characterizing antennas.

This traineeship is a follow-up of the course EM waves & antennas (5MF00).

The student will be introduced to the cavity model for analyzing microstrip patch antennas. After self-study of this model, an initial antenna design, meeting the specifications as laid down by the supervisors, will be generated. This initial design will serve as input for a (student-licensed) commercially available EM analysis software package. This tool will be used to fine-tune the initial design. A prototype will be realized by the student, employing prepared FR4 PCB material, adhesive copper-foil, knife and ruler and soldering iron. Next, the antenna will be characterized by measuring the input impedance as function of frequency and the principal plane radiation patterns employing a vector network analyzer and a far-field setup in an anechoic chamber.

At the end of the traineeship period the student or group of students (max 2 persons) will write a report and give a presentation. Report and presentation will focus on the understanding of the problem, implications and relevance for the design and the performance of the realized antenna.

Type of education: Instruction, assignment and coaching.

Type of examination: Written report and oral presentation.

5N290 (5Z010) Signal Processing Systems 4 ECTS

Lecturers: dr.ir. P.C.W. Sommen; ing. A.C.P. van Meer.

The course consists of six morning or afternoon sessions of three hours each. Besides a general overview of signal processing applications and the DSP architecture these sessions will give an introduction to the practical part. The course will be completed with an assignment that can be carried out in pairs.

Aim: after this courses the student has:

- gained knowledge of the broad application area of signal processing;
- gained knowledge of specific architectures for digital signal processors and the consequences for the use of these architectures;
- passed through the entire design of a Signal Processing System, on the basis of the development of a (practical) application on a digital signal processor;
- written a concise report of the practical part of the course;
- proved in an individual oral exam that he/she has an overall view of both the theoretical and the practical aspects of the entire design process of a Signal Processing System.

Basic knowledge: the student must be academically and technically formed. Knowledge of the courses "Digitale Signaalbewerking (5J040), Stochastische Signaaltheorie (5H130) and Computerarchitectuur (5B040)" or equivalent subjects is assumed to be present.

Form of education: lectures and assignment.

Form of examination: oral defense of the report (app. 30 minutes).

Schedule: to be planned in consultation with participants, preferably end of Winter/beginning of Spring term.

Study material: will be handed out during the course.

Contents: the program of the course is divided as follows:

1. Cursory part (study load 30 hours):

- A survey of the broad application area of signal processing, including a focusing on a number of subjects mentioned and related to this area.
- An overview of specific architectures for digital signal processors and the consequences for the use of these architectures.

2. Practical part (study load 80 hours):

In small groups the student will go through the entire design trajectory on the basis of the development of a practical application on a digital signal processor.

3. Report (study load 10 hours):

Every group of students is expected to make a concise report of the practical part (one copy each lecturer). This report must at least contain the following items:

1) Definition of the problem.
2) The chosen approach.
3) Description of the realization.
4) The experiments carried out.
5) Detailed documented software.
6) Conclusions.

5P050 Capita Selecta in Electronics 4 ECTS

Lecturers: prof. Dr. Ir. A.H.M. van Roermund, dr.ir. J.A. Hegt, dr. R. Mahmoudi
Department Electrical Engineering, Mixed-signal Microelectronics

Type of education: independent learning, no lectures.

Objectives: Providing insight in special design features of modern analog IC electronics

Contents:

The student makes a choice in consultation with the lecturer out of various subjects. A choice of:· Neural networks, Phase locked loop systems, High frequency transceivers, AD and DA conversion, Switched-capacitor circuits.

5P630 Special Topics in Power Electronics 4 ECTS

Lecturers: dr. J.L. Duarte and visiting lecturers.

Type of education: 10 weeks lecture, 3 hours each.

Objectives: To acquire insight in modern power electronic components and their applications.

Contents:

Voltage source converter as a basic circuit topology in present-time power electronic systems; application of pulse-width modulated dc-ac and ac-dc converters; Pulse-width modulation techniques and current control of voltage source converters; practical issues such as power losses calculation, design of current controllers, dynamic control of dc-bus voltage, lab demonstrations; Application of voltage source converters in the public grid; grid connection of dispersed energy generation; Magnetics: review of basic theory, characteristic properties of magnetic materials, ferrites; modelling of energy losses in cores and windings; parasitics; safety aspects; design examples.

5TT00 Optical Communication Networks 3 ECTS

Lecturers: prof. ir. A.M.J. Koonen, dr.ir. E. Tangdiongga

Type of education: 10 weeks lecture, 2 hours each.

Objectives:

This course extends the knowledge on the basics of optical communication.

Contents:

This course comprises a thorough treatment of optical communication networks. It builds on pre-knowledge of the basic characteristics of optical sources, detectors, and fibres. The topics addressed are: topologies of optical communication networks, application of key building blocks, optically repeatered links, non-linear effects, optical multiplexing, optical circuit- and packet-switching, optical packet labeling (serial, subcarrier, out-of-band, combined modulation), optical core meshed networks, SDH network operation principles and protection strategies, optical cross connects, label-controlled packet routing nodes, optical metro networks (hubbed, peer-to- peer, WDM rings), add-drop nodes, protection mechanisms, resilient packet ring, storage area networks, optical access networks architectures (FTTH, FTTH, FTTC), multiple access strategies (TDMA, APON, EPON, GPON, WDMA, SCMA, OCDMA), hybrid fibre networks, radio over fibre techniques, in-building optical networks, free space optical communication.

IMS – platform for IP-based applications in UMTS

TNO Telecom, Delft

Objective of the course

This course aims at teaching the basics of the 3G IP Multimedia Subsystem (IMS). How does it fit within the UMTS architecture, and what is the vision behind IMS. The course explains the general principles behind the IMS architecture and pays attention to the different ‘planes’: signaling, session control, and media. Finally, the basics of building services with the IMS are explained.

When the course has been completed successfully, the student is able to participate in a discussion with a telecom operator on the background of IMS, its architecture and protocols, and SIP-based service examples.

The training consists of the following parts:

- Studying the material provided (see below), and participating in sparring sessions with TNO experts. It is useful to have these discussions at TNO ICT, Delft. In more detail:
  - ✓ Introduction, chapter 1 + introduction to 3GPP website
  - ✓ Chapter 3
  - ✓ Chapter 4, 5
  - ✓ Chapter 7, 9
  - ✓ Chapter 11, 13
  - ✓ Chapter 16-20
  - ✓ Exam

Course material

Book:
The 3G IP Multimedia Subsystem – merging the internet and the cellular worlds, Conzalo Camarillo, Miguel A. Garcia-Martin, Wiley, 2004.

The book contains a lot of background material on the standard that is not meant for "memorizing". In consultation with the teacher it can be decided to what extent the material needs to be studied.

Contact: Ir. Tomas Cordenier, 015-2857070, email: tomas.cordenier@tno.nl

UML – practice what you (pr/t)each

TNO Telecom, Delft

Objective of the course:

Main philosophy for the course is that studying and learning UML is done best by applying it to a (realistic) practical case. TNO ICT is working on the case of the mobile civil servant ("mobiele ambtenaar"). This case is particularly suited for applying UML, thereby encoding a number of business processes behind the services. The web services that are used in the case are GnTel, some TNO-internal web services related to the Asterisk platform, and some external web services like email and MapPoint.

The training consists of the following parts:

- Studying the material provided (see below), and participating in discussions / sparring sessions with two TNO experts. It is useful to have these discussions at TNO ICT, Delft, or in Nijmegen (at the university).
- Translating the case of the "mobiele ambtenaar" into UML. The UML toolkit can be used "off-line", i.e. outside TNO, but it is desirable to have a few face-to-face interactions with the TNO experts at TNO premises in Delft.
- When time is left / everything goes smoothly: translating UML code to Java. This can be done in a more or less automated fashion, but this will provide an actual demo.

Course material:

UML™ for the IT Business Analyst: A Practical Guide to Object-Oriented Requirements Gathering, Howard Podeswa, Course technology, 2005

Poseidon plug-in for Eclipse (professional ed. 4.0)

Manual for Poseidon UML Toolkit: http://gentleware.com/userguides.0.html

Contact: Ir. Paul Brandt, phone: 015-2857056, email: paul.brandt@tno.nl

Ir. Olof Schuring, phone: 015-2857260, email: olof.schuring@tno.nl

Description of cases:

Integrated law enforcement

Integrated law enforcement relates to the efficient use of available human resources: civil servants will be able to perform all sorts of tasks when they are timely provided with the correct information supporting those tasks. Information will be pushed to them based upon their expertise, their actual location or the urgency of the task at hand. On their way through the city, the civil servants themselves can instantiate new tasks if circumstances require so. On resolving their tasks, communication can be setup with task stakeholders such as originators or experts, without the need to consult a telephone directory.

The concept behind the case is based upon the paradigm of "self-directed scheduling" where the employees themselves will schedule and manage the outstanding tasks in stead of the paradigm where tasks are managed and scheduled centrally.

Inspector hazardous goods

The concept behind the integrated law enforcement case is equally well applicable to other domains of application, such as inspection and management of hazardous goods.Incidents and regular jobs are stored centrally but scheduled and resolved locally on employee's initiative. Clearly, although ICT can be viewed as enabler for these applications, these applications can only succeed when taking the business and organizational perspective into account as well, especially since the paradigm of "self-directed scheduling" will have a major impact on the organization and its processes.

Elective courses

By means of electives and special assignments, course participants are provided the opportunity to gain specialist knowledge in one of the study program specialization's.

Literature study for knowledge acquisition is used in the study program. The number of study credits and the type of examination is determined in consultation with the supervising professor. This agreement must be recorded in the OBP.

Within the study program trainee design engineers may include domestic or external traineeships next to the regular assignments, lectures, and literature studies. The number of credits depends on the nature and length of the traineeship.

The total amount of credit points for elective courses should be (at least) **20 ECTS** (1 ECTS = 28 h workload in average). At least five (elective) courses, to be proposed by the TU/e coach/supervisor, provides the PDEng candidate the required basic knowledge for the future (industrial) project. The courses can be chosen from regular M.Sc-courses offered in the TU/e Department Electrical Engineering, as well as courses from other Departments (or universities), courses from other TU/e Stan Ackermans Institute post-masters Designer programs (for example Software Technology) and 1 - 2 remaining courses (if applicable) from the mandatory specialization courses as being offered. See the links to the relevant web sites:

General information about courses offered by TU/e: http://owinfo.tue.nl/

Electives TU/e Electrical Engineering:
http://w3.ele.tue.nl/nl/onderwijs/studieprogrammas/electiveskeuzevakken_verwijzing

TU/e SAI Designer's Program Software Technology:
http://wwwooti.win.tue.nl/

TU/e Centre for Mathematical Applications and Software (CeMAS):
http://www.win.tue.nl/cemas/en/ictcursussen.html

5Z037 External course (2 ECTS)

5Z020 External course (3 ECTS)

5Z021 External course (4 ECTS)

5Z022 External course (5 ECTS)

5Z035 External course (6 ECTS)

5Z017 Internal course/assessment/literature study (1 ECTS)

5Z036 Internal course/assessment/literature study (2 ECTS)

5Z041 Internal course/assessment/literature study (3 ECTS)

5Z042 Internal course/assessment/literature study (4 ECTS)

5Z043 Internal course/assessment/literature study (5 ECTS)

5Z044 Internal course/assessment/literature study (6 ECTS)

Final project (5Z500) 60 ECTS

The study program for trainee design engineers is completed with an industrial design project (12 months full-time), in which the knowledge, insights, and skills that have been acquired are applied in practice.

In the final project the designer must show the ability to:

- Analyze the goal and the context of the design project.
- Write a system requirements specification.
- Translate the functional and market demands into a conceptual solution.
- Develop a test specification.
- Perform design space exploration and select the most appropriate technologies.
- Synthesize (design) a product.
- Evaluate products' performance and check, whether the requirements specification is fulfilled.
- Manage the project in close collaboration with both the industrial partner and the TU/e supervisor by (a.o.):
  - Communicate project's status, deliverables and results per phase.
  - Writing managerial decision documents (Project Based Management).
  - Organizing project meetings.
  - Proposing design-iterations.
- Work in a multidisciplinary team.
- Write a final report according to the guidelines (see below). This document includes requirements specification, project deliverables, management plan, project control, time and budget management.

It is preferred that the project has an integrative nature, which can be achieved through co-operation with several (sub) disciplines.

The project's results must be publicly defended in a committee consisting of (at least one) supervisor from the industrial partner (project owner), TU/e supervisor and the Director of the SAI Program on Information and Communication Technology.

Guidelines for final reports

The final report consists of 25 to 30 pages of main text including requirements specification, project deliverables, management plan, project control, time and budget management, references, etc.

The design report, which must be written in English with the terminology of the party that commissioned the assignment, must contain the following:

1. A short, clear summary. The summary must be in English. The report must contain a clear, short summary that can be understood by non-specialists.
2. Management advice (max. 1 page). This includes a description of the project solution with a trajectory of decisions for the manager, costs, and the pros and cons of various alternatives.
3. Table of Contents
4. A clear and concise formulation of the objective of the design project and its context.
5. Description of the actual design and the applied design process; details should be included in the appendices.
6. Summary of the test results and the validation of the realized design.
7. Evaluation of the design process, including self-evaluation.
8. Proposals for future developments.
9. Conclusions.
10. Appendices (see below).
11. References.

Appendix to final report

The Appendix is an updated version of all relevant design documentation, including the Baseline Document, part of the course Project Based Management. It must contain the following items:

1. The original design assignment:
   - Which party commissioned the assignment? What was the definition of the design assignment?
   - Special boundary conditions, such as: time, budget, manpower, and business conditions.
2. Analysis of the design assignment:
   - Requirements capture and analysis.
   - System requirements specification.
   - Test specification.
   - Description of the detailed design assignment.
3. The planned design process:
   - Points of departure.
   - Planning of the structured design process in distinctive stages.
   - Specification of the design activities to be carried out (component tasks) in each stage.
   - Specification of the participants and their expertise in each stage.
   - Risk and error analysis of each component design.
   - Time planning (milestones).
   - Planning of resources.
   - Cost estimation.
4. Actual design description
   - System level design
   - Detailed design.
5. Test and verification
   - Test manual
   - Test rapport

6. User manual
7. The design process carried out:
   - Description of the choices made and argumentation behind decisions that were made.
   - Reflection

Applying for a job

Participation is open to all SAI trainees.

This course should be viewed as service to trainees of Stan Ackermans Institute. The course does not involve any study credits for the Training and Supervision Plan (OBP).

The course consists of eight evening meetings, each lasting 2.5 hours. The subjects covered include:

1) Insight into job application, self-assessment: making an inventory of experiences and formulating them for job applications, elaborating on success stories, homework assignment: exercises for self-assessment.
2) Follow-up to the self-assessment: self-analysis of strengths and weaknesses, inventory of career values, career profile anchors, homework assignment: job market profile and job market analysis.
3) Completion of self-assessment: drawing up a job market profile, summary of the profile for the job applicant, job market exploration, making a profile of the job market, homework assignment: networks and job application letter.
4) Giving presentations. Each meeting a few of the course participants will take turns practicing at applying for a job, submitting a job application letter, networks: what they are, what their significance is, how to get one, exercises and a homework assignment.
5) Presentations, discussion of the homework assignment, discussion of the job application letter and résumé of each participant, homework assignment: preparing for the job interview.
6) Presentations, preparing for the job interview: the first impression, controlling the discussion, being convincing, non-verbal aspects (posture, dress, eye contact, voice, etc.), exercises with applicant selection questions that can occur during an interview.
7) Practice interview with personnel officer from industry, based on the letter and résumé. Interviews take place on two evenings so course participants have a choice. Each interview is evaluated and recorded on video.
8) The video recording of the practice interview is discussed with the trainer. The course is evaluated and rounded off.