SECOND CYCLE STUDY PROGRAM SPECIFICATION

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1. PROGRAM DESCRIPTION

1.1 Introduction

The advances in computer technology have added new fuel to the development of almost all of the science and engineering applications. Because of its role in the improvement of civilization, this discipline became a separate engineering profession. In today's age of information, Information Technology is one of the main branches of engineering that contribute through professional services towards more prosperous and sustainable society.

1.2 Mission

The mission of the Department of Information Technology is to educate the students to gain an understanding of the fundamentals of science and engineering so that they can develop solutions to Computer Engineering problems and enhance their skills on computer science, computer architecture, design and analysis of algorithms, software engineering communication and research skills. It is aimed to especially emphasize teamwork, independent and innovative thinking and leadership qualities.

1.3 Aims of the Programme

- To facilitate the provision of a quality learning experience for each student that fosters engagement with their programme of study and promotes independent study and life-long learning;
- To maintain a high quality, comprehensive and coherent computing focussed curriculum informed by research, scholarly activity and practice which enhances each participant’s career prospects;
- To develop professionals with a sound understanding of computing and a critical awareness of current issues, who are able to adopt appropriate research strategies, and are informed of wider contextual issues;
- To encourage the creative and appropriate application of technology to promote innovation, enterprise and employability;
- To promote ethical awareness and professionalism supported by a strong appreciation of industry focussed skills and practice.
- To promote students’ self-discipline and self-assurance and the ability to learn on their own,
- To produce graduates for the engineering and the business communities who are observant, inquisitive and open to new technologies for developing better solutions,
- To produce graduates for the engineering and business communities with integrity, determination, judgment, motivation, ability and education to assume a leadership role to meet the demanding challenges of the society.

1.4 Program

The Information Technology master program is based on two years Masters Degree Program with 120 ECTS credits. The first year of the program is dedicated to the study of advanced engineering courses of computer engineering. The Curriculum of the program includes elective courses, which give an opportunity to students to improve their professional skills according to their interests. The requirements for an MS degree in Information Technology include the completion of minimum of 120 ECTS credits of formal course work and thesis. The students who completed the master degree level can continue to attend PhD level on their demand and if they meet the minimum GPA of master level conditions. The academic program of department of IT is competency based, and designed to prepare students for higher-level positions as information technology professionals. The topics covered in IT course work include:

- the role of information technology in global society;
- the development of Internet business sites and electronic commerce;
- the role of information systems in business and government;
- fundamentals of computer programming, data analysis and networking;
- database concepts, applications and design;
- information systems analysis, design and implementation;
- Information security, information assurance and network security.

1.5 Learning and Teaching

Learning and teaching methods provide high quality learning opportunities that enable students to demonstrate achievement of the learning outcomes of the course and those of the modules which constitute their chosen route of study.
The course aims to foster the development of independent study skills and autonomy of learning and encourage a commitment to lifelong learning and continuous professional development. Teaching and learning methods increasingly promote the capacity for students to assume responsibility for their own learning and development. Progressive use of project learning, integrated assessment and product/problem based learning allow students to take on greater self-direction of their learning. Emphasis is often placed on group and team working throughout the study.

The course employs a wide range of learning opportunities and teaching methods, informed by curriculum review, pedagogic research and continuous staff development. Particular methods for each module or cohort are identified prior to delivery through the annual planning process. Innovative approaches to teaching, learning and assessment are encouraged. The course seeks to expand the application of technology in the delivery of teaching and learning support wherever appropriate.

Scheduled sessions will include the use of lectures, seminars and practical sessions. Advantage will be taken of both technology and supportive activities to ensure that effective learning takes place. These activities will include the use of simulations, role play, case studies, projects, practical work, work based learning, workshops, peer group interaction, self managed teams and learner managed learning.

1.6 Teaching/learning methods and strategies

**Lectures/classes:** offer information, literature review and illustrative application and present and explore core ideas in the subject. A student will apply intellectual skills to prepare solutions to examples sheet questions which will be discussed in a small class.

**Practical sessions:** computational methods are taught as a series of computer-based practicals with short introductory lectures on theory. This enables a student to understand issues in application of computational methods to simulated and real problems and also develop computing skills relevant to the rest of the course including the research project. Practicals, computer-based and experimental lab based, provide an opportunity for a student to consolidate the theory they have learned about in lectures and apply it to problems.

**Group project:** provides an opportunity to study a real computer engineering problem in depth, practice analytic and problem-solving skills, and work in a team.

**Individual project:** involves a literature review, problem specification and experiments/analysis written up in a report. This enables a student to practice the application of techniques they have learned about to a technology problem in some depth as well as put into practice general research skills.

**Expert (guest) lectures and seminars:** provide a student with the opportunity to hear internal speakers and external speakers from industry. This enables a student to gain appreciation of some applications, needs and roles of computer engineers as well as career opportunities.

1.7 Assessment Protocols

The purpose of outcomes-based learning assessment is to improve the quality of learning and teaching in Information Technology department. The fundamental principles are:

- Student learning is the central focus of the department’s efforts.
- Each student is unique and will express learning in a unique way.
- Students must be able to apply their learning beyond the classroom.
- Students should become effective, independent, lifelong learners as a result of their educational experience.

Assessment of the IT Learning Outcomes (ITLOs) begins with the normal assessment process in the major courses that are taken by students. Each course defines course outcomes and relates the course outcomes to the ITLOs. Students also prepare portfolios that reflect their achievements and capabilities, and the evaluation of the portfolios by a faculty committee represents the final assessment of a student’s achievement in the ITLOs.

1.7.1 Assessment

Assessment of knowledge and understanding is by:

Unseen written examinations
1.8 Learning outcomes

The Master of Science in Information Technology program will enable graduates to understand and articulate the different levels and aspects of information technology in the context of an enterprise. The Major Learning Outcomes for department of Information Technology are as follows:

**Critical Thinking and Quantitative Reasoning in IT**: IT graduates will be able to use critical thinking and quantitative processes to identify, analyze and solve problems, and evaluate solutions in an IT context.

**Information Technology Application**: IT graduates will be able to select existing and cutting-edge IT tools and procedures to develop modules and systems.

**Information Technology Management**: IT graduates will be able to assess and determine information resource requirements to develop solutions suitable for IT and business managers operating in a multinational and multicultural environment.

**Information Technology Professional Practice**: IT graduates will be able to work effectively in individual and group situations, understand how groups interact, be able to assume a leadership role when required, and understand the fundamentals of professional and ethical conduct.

**Information Technology Systems Theory and Practice**: IT graduates will be able to understand and communicate the fundamentals of systems theory in the development of appropriate systems that function in a global environment.

On successful completion, IT department master students will be able to demonstrate:

- a systematic understanding of key aspects of computing, including acquisition of coherent and detailed knowledge, at least some of which is at, or informed by, the forefront of defined aspects of a discipline
- an ability to deploy accurately established techniques of analysis and design
- a wide breadth of understanding that enables them to devise and sustain arguments and solve problems using ideas and techniques, some of which are at the forefront of computing practice, and describe and comment upon particular aspects of current research, or equivalent advanced scholarship
- an appreciation of the uncertainty, ambiguity and limits of knowledge
- consistent application of the development methods and techniques that they have learned to review, consolidate, extend upon, and to initiate and carry out projects to a professional level
- an ability to critically evaluate arguments, assumptions, abstract concepts and data, to make judgements, and to frame appropriate questions to achieve a solution – or identify a range of solutions – to a problem.

1.9 Skills and other attributes

On successful completion of master level students should be able to demonstrate they:

- have the ability to manage their own learning, and make use of scholarly review and primary sources (for example, referred research articles and/or original materials appropriate to the discipline)
- can communicate information, ideas, problems and solutions to both specialist and non-specialist audiences
- they have the qualities and transferable skills requiring the exercise of initiative and personal responsibility, decision-making in complex and unpredictable contexts and the learning ability needed to undertake appropriate further training of a professional or equivalent nature

1.9.1 Intellectual skills

By the end of the course a student will have developed skills in:

- Synthesis: integrate theory and practice, and devise appropriate theoretical models of computer engineering systems.
- Computational analysis: select and apply appropriate computational techniques to solve a given problem
• Experimental analysis: acquire, analyse and interpret synthetic and experimental data and understand the strengths and limitation of using each type of experimental data analysis.
• Critical analysis: read, critique and discuss scientific articles, especially those that cross discipline boundaries between engineering and other fields. Present a written argument based on reading from a variety of sources.
• Problem solving: apply engineering principles to solve different problems.
• Evaluation: interpret experimental data scientifically and demonstrate skills necessary to plan, conduct and report on a research project

1.9.2 Discipline-specific Practical skills

By the end of the course a student will be expected to have practical skills to enable them to:
• select and apply appropriate computational methods to solve different engineering problems.
• use information technology for the collection and analysis of experimental data.
• undertake a research project independently and with minimal supervision/guidance.
• understand issues in and have gained experience in working in multi-disciplinary teams.

1.9.3 Transferable skills

By the end of the course a student will have developed a range of transferable skills including skills in:
• Managing their own learning and conducting independent thinking and study
• Problem specification and modelling
• Applying mathematical and computational methods to solve (engineering) problems
• Use of general information technology
• Managing a research project, including planning and time management
• Conducting an engineering-based research-based work, from hypothesis to report writing
• Working in a multi-disciplinary team
• Critical analysis

1.10 Methods for Evaluating and Improving the Quality and Standards of Teaching and Learning

- Student Focus groups and the annual student survey
- Class room observation of Lecturers
- Advanced Professional Diploma in Teaching and Learning in Higher Education
- Membership of the Higher Education Academy
- External Examiners reports
- Accreditation Visits
- Curriculum Area Review
- Course Committees
- Annual and periodic review

a) Mechanisms for gaining student feedback on teaching quality and their learning experience

Questionnaires collected for each component of the course and considered by the course director/tutors in a department meeting and acted on as appropriate. Termly individual meetings between students and the Course Director. Self-assessment progress reports completed by students at the end of each term.

b) Mechanisms for the review and evaluation of teaching, learning, assessment, the curriculum and outcome standards

Departmental meeting in June/July at which course tutors consider current course structure, delivery arrangements, student performance in assessment, and student feedback and make recommendations for change and improvement. Also used to help spread best practice for teaching and learning techniques. Examiners reports (both internal and external) on the examinations in a particular year, commenting on pass rates, standards of learning and examination performance. Teaching evaluation questionnaires. Annual Course Director report to the Department Academic Committee with details on admissions, staffing, course changes and feedback, student performance, destination of graduated MSc students, and any difficulties encountered on the course. Student destination, whether employment or further study. An Advisory Board (from industry and clinical practice) providing occasional and valuable comments on the progress and development of the course from their respective perspectives.
1.11 Indicators of Quality and Standards

- Student feedback
- Retention and success rates for each level for each course
- Student Module Evaluations
- Annual Student Questionnaires
- First Destination Statistics
- Professional accreditation
- External Examiner reports

1.12 Criteria for Admission

The admissions policy for overall Scheme, in which the Computing course operates, is to admit any applicant who is capable of benefiting from and successfully completing their chosen course. Where selection criteria are devised they will be tuned to satisfy the widening participation agenda and equal opportunity policy of the University. Admissions profiles will be reviewed annually as will selection criteria and will provide a fair and objective basis for selection to oversubscribed courses. Admission with advanced standing will follow University Procedures. Applications will normally be considered in the light of a candidate’s ability to meet the following criteria:

a) Academic ability

1) The applicant has provided appropriate indications of proven and potential academic excellence. Appropriate indicators include two or more confidential references, academic transcripts or their equivalent, (on the application form) a statement outlining how the course will help progress the applicant’s career, and performance at interview.

2) The applicant has provided sufficient evidence, in the view of the assessor, to suggest that they have the academic ability and commitment to pursue the chosen programme to a successful conclusion within the required time limits. This includes; a sufficient level of mathematics and/or computer programming completed on the first degree or otherwise as a foundation for successful completion of the course; an understanding of how the MSc will help the applicant progress their career, and evidence of the ability (prior experience or potential) to work in a multi-disciplinary team.

3) Applicants are normally expected to have achieved a Honours Degree (or equivalent) in engineering, physical sciences, mathematics, computer science subject, or a related subject.

b) English Language Requirement

Applicants whose first language is not English are required to provide evidence of proficiency in English. Candidates are normally expected to meet the following criteria:

For IELTS an overall score of 5
For TOEFL an overall score of 450, or for the computer-based test, an overall score of 200 or equivalent score.

c) Suitability

1) The programme of study that the applicant wishes to pursue is well suited to the academic interests and abilities to which they have drawn attention in their application and (where appropriate) the applicant has undertaken any preliminary academic work or course which is normally considered indispensable to acceptance on the proposed programme of study.

2) The Department of IT is able to provide appropriate supervision and facilities for the candidate’s chosen programme of work.
## 2. CURRICULUM: MASTER OF INFORMATION TECHNOLOGIES

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### 3. COURSE DESCRIPTION

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<tr>
<th>Course Code</th>
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<td>CEN 511</td>
<td>WEB ENGINEERING</td>
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#### Level: Graduate  
#### Year:  
#### Semester:  
#### Status: Compulsory/Elective  
#### Hours/Week: 3  
#### Total Hours: 45

**Instructor:**

Digital libraries are complex systems that are intended for use by diverse audiences. A thorough, systematic approach is required for the successful development of digital library projects. Web Engineering introduces a structured methodology utilized in software engineering to Web development projects. The course addresses the concepts, methods, technologies, and techniques of developing Web sites that collect, organize and expose information resources. Topics covered include requirements engineering for Web applications, design methods and technologies, interface design, usability of web applications, accessibility, testing, metrics, operation and maintenance of Web applications, security, and project management. Specific technologies covered in this course include client-side (XHTML, JavaScript, and CSS) and server-side (Perl and PHP).

**COURSE OBJECTIVES**

The goals of the course are as follows:

- To be able to analyze and design comprehensive systems for the creation, dissemination, storage, retrieval, and use of electronic records and documents.
- To learn and use some of the client-side and server-side languages used to manipulate information on the World Wide Web – i.e. PHP, and Javascript.
- To learn techniques and evaluation metrics for ensuring the proper operability, maintenance and security of a web application.

**COURSE CONTENTS**

CEN 511 is a special topics course in Web Engineering for students in the library & information sciences and related disciplines. Web Engineering focuses traditional software engineering to the design, coding, and deployment of web applications. The course is intended for students who are interested in developing or maintaining web applications in the roles of project managers or digital librarians. Being a graduate level course, CEN 511 is not designed to be purely programming, although the course’s assignments and projects do emphasize programming. The point of this class is to develop a broad understanding of engineering and maintaining web applications at a conceptual level, using programming as a learning tool by applying these concepts to practical assignments. The first four weeks of the course will focus on the design stages of web application development. We will examine the web application development process, requirements gathering, modeling applications, and project management. Coupled with previous coursework in system architectures and interactive design, the first part of the course lays the foundation for the remainder of the semester. The focus of the second four weeks shifts to programming on both the client and server sides. Languages and techniques include Javascript and an introduction to AJAX on the client side, Perl and PHP on the server side. While .NET and Java technologies will be discussed contextually, Perl and PHP have been selected as simpler more transparent technologies appropriate for a first introduction. Students with accounts on SIS’s web server, Paradox, have the ability to create CGI or PHP scripts (and thus, do the assignments) without the overhead of having to install and configure their own development environment. Second, the main goal of the course is for students to learn (and experience) the entire web engineering process, not to focus purely on learning a larger enterprise solution. The final four weeks are devoted to the latter stages of the web application development cycle. Topics include testing, performance measurement, operation and maintenance, and security. During this time, students will also focus their time on working on their final project, which ties together the concepts and techniques learned throughout the course.

**TEACHING/ASSESSMENT**

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<tr>
<td>Participation of different teaching methods depends on the subject.</td>
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<table>
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<th>Teaching Methods</th>
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2. Discussions and group works  
3. Presentations(4-5 students per semester) | |

<table>
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<th>Student Assessment</th>
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<td>Project</td>
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Instructor: 

**COURSE DESCRIPTION**

This course will teach the student to program using the programming language available in a relational database management system. The student will learn to work with fourth generation language programming and will analyze, design and develop, write and execute programs in a database environment.

**COURSE OBJECTIVES**

The objective of this course is to help the student become an effective database programmer using Visual dBase. At the completion of this course, the following objectives should have been accomplished:

- learn to develop a normalized relational database
- learn to setup and maintain a database
- learn to design a program to meet a business need
- learn to write a database program using a structured style
- learn to write a database program using an object oriented style
- learn to work with the visual components of Visual dBase
- learn to execute and debug problems in database programs

**COURSE CONTENTS**

I. Introduction to Visual dBase files
   A. Creating a file
   B. Commands to list, query and maintain the file

II. Structured programming using dBase
   A. Introduction - linear
   B. Loop - Do While etc.
   C. Decisions - IF
   D. Menus and screens
   E. Procedures and Do Case
   F. Organizing a system
   G. Indexes
   H. Retrieval and updating/maintenance
   I. Data manipulation

III. Designing the database
   A. Concepts
   B. Techniques
   C. Relational
   D. Normalization
   E. Implementing using dBase

IV. Visual dBase - object oriented programming
   A. Introduction
   B. Differences in programming design and concepts
   C. Implementing the basic building blocks from structured
   D. Dialog boxes
   E. Creating tables from within
   F. Joining
   G. Other object implementations

**TEACHING/ASSESSMENT**

<table>
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<tr>
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**Learning outcomes**

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**Language of Instruction**

English

**Textbook(s)**

Several optional reference books are available at the bookstore. The class will focus on the information available at this Web site.

Students with a PC at home should strongly consider buying Visual dBase v 7.5.
Course Code : CEN 521  
Course Title : LOGIC PROGRAMMING

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**COURSE DESCRIPTION**

Review of the principle of mathematical induction; the principle of structural induction; review of Boolean algebras; Syntax of propositional formulas; Truth and the semantics of propositional logic; Notions of satisfiability, validity, inconsistency; Deduction systems for propositional logic; Completeness of a deductive system; First order logic; Proof theory for FOL; Introduction to model theory; Completeness and compactness theorems; First order theories. Programming exercises will include representation and evaluation; conversion to normal-forms; tautology checking; proof normalization; resolution; unification; Skolemization; conversion to Horn-clauses; binary-decision diagrams

**COURSE OBJECTIVES**

The objective of the course will be to introduce the main notions of mathematical logic: logical notations (syntax) and how to assign meaning to them (semantics). We will motivate some uses for mathematical logic in the field of computer science. We will then study formal frameworks (in the sense of being rigorous as well as in the sense of manipulating "form") for constructing logical arguments (proof theory), studying in particular some deductive systems for propositional and first-order logic. Naturally, we will be concerned with the correctness and completeness of these deductive systems, as well as with the algorithmics.

**COURSE CONTENTS**

Logic has been called "the calculus of computer science". The argument is that logic plays a fundamental role in computer science, similar to that played by calculus in the physical sciences and traditional engineering disciplines. Indeed, logic plays an important role in areas of Computer Science as disparate as architecture (logic gates), software engineering (specification and verification), programming languages (semantics, logic programming), databases (relational algebra and SQL), artificial intelligence (automatic theorem proving), algorithms (complexity and expressiveness), and theory of computation

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**Language of Instruction**

English

**Textbook(s)**

  ISBN: 0-201-41643-3
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Course Code : CEN 531  
Course Title : PROGRAMMING LANGUAGE DESIGN

Level : Graduate  
Year :  
Semester :  
ECTS Credits : 7.5

Status : Compulsory/Elec  
Hours/Week : 3  
Total Hours : 45

Instructor :

**COURSE DESCRIPTION**

Lexical and syntax analysis, top-down and bottom-up parsing techniques, semantic analysis, symbol tables, error detection and recovery, type checking, code generation and optimization. Case study: Implementation of a compiler for a simple but nontrivial subset of a modern programming language. Basic computer literacy, fundamentals of computer programming, algorithm development and problem solving using flowcharts and pseudo codes, data types, constants, variables, basic input/output, sequences, selection and repetition structures, functions and arrays. Searching and sorting, abstract data types, structures, pointers, strings, input/output, file processing.

**COURSE OBJECTIVES**

The objectives of this course are to develop a basic understanding of programming concepts and using these programming concepts in C language. Structured programming concept is introduced. Programming constructs such as sequential structures, selection structures, and repetition structures are explained. As for programming with C languages, variables, if-then-else, loop structures: for/while/do-while, break/continue/switch statements, flowcharting solutions, arrays are covered.

**COURSE CONTENTS**

- Course Introduction, C Programming
- Simple data types, constants and variables, arithmetic in C, equality and relational operators, Assignment, function calls
- Structured Programming, algorithms, pseudo-code, control structures (sequential, selection, repetition)
- Control structures (Selection: if-else statements and nested selection and switch structure)
- Control structures (Repetition: counter-controlled and sentinel-controlled repetition with while)
- Control structures (Repetition:for and do while)
- Control structures (Nested repetition), Break and continue statements
- Functions: Program modules in C, math library functions: definitions, prototypes, header files
- Functions: Scope rules, Recursion, recursion versus iteration
- Functions: Recursion, recursion versus iteration, Arrays: Declaring arrays, examples using arrays
- Arrays: Declaring arrays, examples using arrays, passing arrays to functions
- Arrays: Passing arrays to functions
- Arrays: Sorting arrays, searching arrays, Multiple-subscripted arrays

**TEACHING/ASSESSMENT**

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<td>Final Examination</td>
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**Learning outcomes**

- Demonstrate a systematic and critical understanding of the theories, principles and practices of computing;
- Critically review the role of a “professional computing practitioner” with particular regard to an understanding of legal and ethical issues;
- Creatively apply contemporary theories, processes and tools in the development and
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Course Code : CEN 533  
Course Title : HUMAN-COMPUTER INTERACTION  
Level : Graduate  
Year :  
Semester :  
ECTS Credits : 7.5  
Status : Compulsory/Elective  
Hours/Week : 3  
Total Hours : 45  
Instructor :

COURSE DESCRIPTION
Methods and principles of human-computer interaction, human-centered design and development of interactive systems, task-centered system design, user-centered design, qualitative and quantitative methods for evaluating interactive systems with users, graphical screen design, design principles and usability heuristics.

COURSE OBJECTIVES
Human-computer interaction (HCI) is concerned with the joint performance of tasks by humans and machines. HCI stresses the importance of good interfaces and the relationship of interface design to effective human interaction with computers. Specifically, we concentrate on so-called interactive systems. On completion of the course you will: · have a theoretical knowledge and practical experiences in the fundamental aspects of designing and evaluating interfaces. · know what is meant good design, and you will have experiences designing systems that are usable by people. · know and have practiced a variety of simple methods for evaluating the quality of an interface.

COURSE CONTENTS
This course is intended to introduce the student to the basic concepts of human-computer interaction. It will cover the basic theory and methods that exist in the field. The course will unfold by examining design and evaluation. Case studies are used throughout the readings to exemplify the methods presented and to lend a context to the issues discussed.

The course is also a design course. You will also apply the theoretical knowledge learned to series of assignments that brings you through selected portions of a design and evaluation cycle. Each student in the course will be asked to develop a human-engineered prototype of a user interface. The students will follow a software development process that applies behavioral techniques to measure and improve the quality of their user interface design. Students will learn how to use survey research, task analyses, design representations and interface evaluation techniques to improve the design of the interface.

Week 1 Introduction to Human-Computer Interaction
Week 2 Task-centered system design
Week 3 Task-centered design
Week 4 User-centered design and prototyping
Week 5 Qualitative methods for evaluation of interfaces with
Week 6 users
Week 7 Psychology of everyday things
Week 8 Return and discuss Assignment 1
Week 9 Beyond screen design
Week 10 Graphical screen design
Week 11 Return and discuss Assignment 3
Week 12 Design principles and usability heuristics
Week 13 Assignment 3 due
Week 14 Past and future of HCI

TEACHING/ASSESSMENT

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Learning outcomes
• Demonstrate a systematic and critical understanding of the theories, principles and practices of
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<tr>
<th>Language of Instruction</th>
<th>English</th>
</tr>
</thead>
</table>
                           ● Brookshear J. G., 2005: Computer Science: An Overview, 8/E, Addison-Wesley |
## Course Code: CEN 537
### Course Title: KNOWLEDGE MANAGEMENT

<table>
<thead>
<tr>
<th>Level</th>
<th>Year</th>
<th>Semester</th>
<th>ECTS Credits: 7.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Graduate</td>
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### Status: Elective

<table>
<thead>
<tr>
<th>Hours/Week</th>
<th>Total Hours</th>
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</thead>
<tbody>
<tr>
<td>3</td>
<td>45</td>
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</table>

### Instructor:

### COURSE DESCRIPTION

This course offers participants the opportunity to explore the framework for knowledge management in education and research. Participants will explore the potential of knowledge management in support of education and research for increasing the capacity of identifying, distilling, harnessing and using information to improve student and institutional success. This course provides the fundamental background for understanding knowledge management and offers necessary resources and practices to enable participants to design and implement a knowledge management strategy in order for education and research initiatives to succeed and flourish. This course includes a strong focus on the implementation of necessary tools and procedures to construct and maintain an outstanding sustainable knowledge management environment for education and research organizations. The course also discusses the impact and benefit for schools if knowledge management is implemented.

### COURSE OBJECTIVES

- Understanding Knowledge
- Knowledge Management Systems Life Cycle
- Knowledge Creation & Knowledge Architecture
- Capturing Tacit Knowledge
- Some Knowledge Capturing Techniques
- Knowledge Codification
- System Testing/Deployment
- Transferring and Sharing Knowledge
- Knowledge Transfer in E-World
- Learning from Data
- KM Tools and Knowledge Portals
- Managing Knowledge Workers

### COURSE CONTENTS

- Understanding Knowledge
- Knowledge Management Systems Life Cycle
- Knowledge Creation & Knowledge Architecture
- Capturing Tacit Knowledge
- Some Knowledge Capturing Techniques
- Knowledge Codification
- System Testing/Deployment
- Transferring and Sharing Knowledge
- Knowledge Transfer in E-World
- Learning from Data
- KM Tools and Knowledge Portals
- Managing Knowledge Workers

### TEACHING/ASSESSMENT

#### Teaching Methods
- Lecturing, presentation, homework

#### Description(%)

<table>
<thead>
<tr>
<th>Student Assessment Methods</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Midterm 15% , Final 20%</td>
<td></td>
</tr>
<tr>
<td>Project(s)/Paper(s) 35% , Classroom Activities 30%</td>
<td></td>
</tr>
</tbody>
</table>

#### Learning outcomes

- Demonstrate a systematic and critical understanding of the theories, principles and practices of computing;
- Critically review the role of a "professional computing practitioner" with particular regard to an understanding of legal and ethical issues;
- Creatively apply contemporary theories, processes and tools in the development and evaluation of solutions to problems and product design;
- Actively participate in, reflect upon, and take responsibility for, personal learning and development, within a framework of lifelong learning and continued professional development;
- Present issues and solutions in appropriate form to communicate effectively with peers and clients from specialist and non-specialist backgrounds;
- Work with minimum supervision, both individually and as a part of a team, demonstrating the interpersonal, organisation and problem-solving skills supported by related attitudes necessary to undertake employment.

#### Language of Instruction

- English

#### Textbook(s)

|----|---------------------------------------------------------------|
**COURSE DESCRIPTION**

Introduces the business applications of information technology. Evaluates the operating characteristics and organizational implications of business information systems from the viewpoint of management. Discusses strategic information planning, organizational change, systems-based decision making, and preliminary methodologies for systems analysis. Examines recent developments in information systems.

**COURSE OBJECTIVES**

Upon successful completion of this course, the student will be able to:
- Identify management information system application opportunities in business and industry.
- Explain the issues involved in the development and deployment of management information systems.
- Investigate the opportunities and problems associated with computer-based management information system that will provide the background for determining the usefulness of computers to assist management in the planning and control of business operations.
- Acquire an ability to participate in IT-enabled organizational systems, evaluate them, and contribute to system development efforts.

**COURSE CONTENTS**

- Week 1, and 2: Information Systems in Business
- Week 3, and 4: Business Fundamentals
- Exam 1
- Week 5, and 6: Information System Fundamentals
- Week 7, and 8: Information System Hardware, Information System Software
- Week 9, and 10: Networking, and Data Management
- Week 11, and 12: Personal Productivity and Problem Solving
- Week 13: Group Collaboration
- Week 14: Business Operations
- Week 15: Management Decision Making
- Week 16: Strategic Impact of Information Systems

**TEACHING/ASSESSMENT**

<table>
<thead>
<tr>
<th>Description</th>
<th>1. Interactive lectures and communications with students</th>
<th>2. Discussions and group works</th>
<th>3. Presentations (4-5 students per semester)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Teaching Methods</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Student Assessment Methods</strong></td>
<td>Homework</td>
<td>Actively Participation</td>
<td>Project</td>
</tr>
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<td></td>
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<tr>
<td><strong>Description (%)</strong></td>
<td>10%</td>
<td>10%</td>
<td>20%</td>
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Learning outcomes:
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<td>Textbook(s)</td>
<td></td>
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</table>
Course Code : CEN 552  
Course Title : DATA MINING

Level : Graduate  
Year :  
Semester :  
ECTS Credits : 7.5

Status : Compulsory/Elective  
Hours/Week : 3  
Total Hours : 45

Instructor :

COURSE DESCRIPTION

COURSE OBJECTIVES
Introducing students to the basic concepts and techniques of Data Mining. Developing skills of using recent data mining software for solving practical problems. Gaining experience of doing independent study and research.

COURSE CONTENTS
- Data Preprocessing
- Mining Frequent Patterns, Associations and Correlations
- Classification and Prediction
- Cluster Analysis
- Mining Stream, Time-Series and Sequence Data
- Graph Mining, Social Network Analysis and Multi-Relational Data Mining
- Mining Object, Spatial, Multimedia, Text and Web Data

TEACHING/ASSESSMENT

Teaching Methods
1. Interactive lectures and communications with students
2. Discussions and group works
3. Presentations (4-5 students per semester)

Student Assessment Methods
- Homework: 10%
- Actively Participation: 10%
- Project: 20%
- Midterm Examination: 20%
- Final Examination: 40%

Learning outcomes
- Demonstrate a systematic and critical understanding of the theories, principles and practices of computing;
- Critically review the role of a “professional computing practitioner” with particular regard to an understanding of legal and ethical issues;
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- Work with minimum supervision, both individually and as a part of a team, demonstrating the interpersonal, organisation and problem-solving skills supported by related attitudes necessary to undertake employment.

Language of Instruction
English

Textbook(s)
- Data Mining: Concepts and Techniques, 1st ed., by Jiawei Han and Micheline Kamber, Morgan Kaufmann, 2001.
<table>
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<th>ECTS Credits</th>
<th>Status</th>
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<td>CEN 553</td>
<td>E-BUSINESS/E-COMMERCE</td>
<td>Graduate</td>
<td></td>
<td>7.5</td>
<td>Compulsory/Elective</td>
<td>3</td>
<td>45</td>
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</table>

**Instructor:**

**COURSE DESCRIPTION**
Electronic processing and transmission of data including text, sound and video for e-business. Electronic trading of goods and services, online delivery of digital contents, electronic fund transfer, electronic bill of lading, direct consumer marketing and after-sales services. E-business security, shopping carts, methods of electronic payments and XML related technologies.

**COURSE OBJECTIVES**
The objectives of this course the understand the systems of e-business theory, e-business models, e-commerce, design, develop and implement e-business, online monetary transaction, Security of e-business, legal issues, political issues, e-learning, Internet banking, hardware and software needs, Internet market.

**COURSE CONTENTS**
- History of Internet, history of web, Internet and World Wide Web Development, E-business and E-commerce overview.
- Structures, mechanisms, economics and models
- Product and service retailing and their principles
- Consumer behaviors, market research and advertisement
- B2B commerce, buying and selling, B2B exchanges and support systems
- E-government, e-learning, C2C, etc.
- Mobile commerce and pervasive computing
- Electronic payment models
- Project presentations

**TEACHING/ASSESSMENT**

**Teaching Methods**
1. Interactive lectures and communications with students
2. Discussions and group works
3. Presentations (4-5 students per semester)

**Student Assessment Methods**

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<tr>
<td>Project</td>
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<tr>
<td>Midterm Examination</td>
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<tr>
<td>Final Examination</td>
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</table>

**Language of Instruction**
English

**Textbook(s)**
- Han J., Kamber M., 2006, Data Mining, Concepts and Techniques, The Morgan Kaufmann Series
- Tan P., Steinbach M., Kumar V., 2006, Introduction to Data Mining, Addison-Wesley.
## Course Code: CEN 554
## Course Title: XML AND WEB SERVICES

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<td>45</td>
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</table>

**Instructor:**

**Course Description:** This course is designed for web developers, students, and programmers wanting to learn XML (eXtensible Markup Language) and the supporting technologies currently used with XML.

**Course Objectives:** This course focuses on XML (eXtensible Markup Language) and the supporting technologies of XML used in person-to-computer and computer-to-computer communications. Some of the technologies covered will include using DTDs (Document Type Definitions), Schema, Namespaces, XPath, DOM, SAX, Data Models, XSLT, SVG, and SOAP as well as web services and the Semantic web.

Here's what the students learn by taking this course:
- How to create an XML document. It's just like HTML only with customized tag names.
- Using DTD and Schemas to validate the XML data.
- How XML can be formatted, filtered, and transformed using a language called XSLT.
- Several common XML technologies including SVG, SMILE, RSS, and SOAP.
- How XML will be used to create the Semantic (intelligent) Web.

**Course Contents:**
2. Create a Document Type Definition (DTD).
3. Demonstrate how the schemas are used in XML.
4. Use namespaces as part of a schema and XLS document.
5. Use RelaxNG to validate XML documents
6. Utilize CSS to control the style of a web page
7. Use XPath to extract text blocks from an XML document.
9. Demonstrate the use of SAX (Simple API for XML).
10. Use XSLT to create HTML pages from XML documents.
11. Create an animated graphic display using SVG.
12. Use RSS as a communication tool between your clients and their customers
13. Demonstrate web services.
14. Demonstrate how SOAP is used as an integral part of web services.

**Teaching/Assessment**

<table>
<thead>
<tr>
<th>Description</th>
<th>Teaching Methods</th>
<th>Description(%)</th>
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</thead>
<tbody>
<tr>
<td>1. Interactive lectures and communications with students</td>
<td>Homework</td>
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</tr>
<tr>
<td>2. Discussions and group works</td>
<td>Actively Participation</td>
<td>10%</td>
</tr>
<tr>
<td>3. Presentations(4-5 students per semester)</td>
<td>Project</td>
<td>20%</td>
</tr>
<tr>
<td></td>
<td>Midterm Examination</td>
<td>20%</td>
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<td></td>
<td>Final Examination</td>
<td>40%</td>
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</tbody>
</table>

**Learning outcomes:**
- Demonstrate a systematic and critical understanding of the theories, principles and practices of computing;
- Critically review the role of a “professional computing practitioner” with particular regard to an understanding of legal and ethical issues;
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<table>
<thead>
<tr>
<th><strong>Language of Instruction</strong></th>
<th>English</th>
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</table>
### Course Code: CEN 555  
### Course Title: SPECIAL TOPICS IN DATABASE SYSTEMS

<table>
<thead>
<tr>
<th>Level</th>
<th>Year</th>
<th>Semester</th>
<th>ECTS Credits</th>
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<td>Compulsory/Elective</td>
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</table>

### COURSE DESCRIPTION
Relational algebra, QBE, normalization theory, physical data organization techniques and indexing, advanced SQL (data control language), query processing, data recovery, security and integrity, object relational data model, XML and XML-related technologies in databases.

### COURSE OBJECTIVES
The objective of this course is to give an advanced introduction to the concepts for modeling, designing, querying and managing large databases. The course covers a spectrum of topics involved with current approaches to modeling and design of databases and the design of DBMSs to manage databases. The relational model is emphasized and relational database management systems are addressed from the standpoint of query optimization, database security, transaction management, concurrency control, and recovery. Other topics to be introduced will include object-oriented databases, distributed databases, data warehousing and mining. Some topics like advanced data models, ODMG and object-relational database management.

### COURSE CONTENTS

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<th>Teacing/Assessment</th>
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<tbody>
<tr>
<td>Description</td>
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</tbody>
</table>

#### Teaching Methods
1. Interactive lectures and communications with students
2. Discussions and group works
3. Presentations (4-5 students per semester)

#### Description (%)
- Homework: 10%
- Actively Participation: 10%
- Project: 20%
- Midterm Examination: 20%
- Final Examination: 40%

### Learning outcomes
- Demonstrate a systematic and critical understanding of the theories, principles and practices of computing;
- Critically review the role of a "professional computing practitioner" with particular regard to an understanding of legal and ethical issues;
- Creatively apply contemporary theories, processes and tools in the development and evaluation of solutions to problems and product design;
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### Language of Instruction
English

### Textbook(s)
Course Code : CEN 556  
Course Title : MULTIMEDIA SYSTEMS

Level : Graduate  
Year :  
Semester :  
ECTS Credits : 7.5

Status : Compulsory/Elective  
Hours/Week : 3  
Total Hours : 45

Instructor : 

COURSE DESCRIPTION
This course covers both theoretical and practical issues in designing multimedia systems. Topics to be covered include introduction to multimedia systems, digital video compression techniques, operating system support for digital audio and video, as well as network and transport protocols for multimedia. An emphasis will be placed on current design issues and research topics. Prerequisites: Familiarity with concepts in graduate computer networks and operating system design.

COURSE OBJECTIVES

COURSE CONTENTS
Overview and Historical Perspective, Image and Media Basics, Video Production and Digital Media, Digital Video and JPEG Encoding, JPEG (DCT) and Introduction to MPEG, MPEG System Layer, MPEG Editing, Video Server and Video Caching, Introduction to Multimedia Networking, Media Synchronization on Network

TEACHING/ASSESSMENT

Teaching Methods
1. Interactive lectures and communications with students
2. Discussions and group works
3. Presentations(4-5 students per semester)

Description(%)

Student Assessment Methods
Homework 10%
Actively Participation 10%
Project 20%
Midterm Examination 20%
Final Examination 40%

Learning outcomes
- Demonstrate a systematic and critical understanding of the theories, principles and practices of computing;
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Language of Instruction  
English

Textbook(s)
Mpeg Video : Compression Standard (Digital Multimedia Standards Series) by by Joan L. Mitchell (Editor), William B. Pennebaker (Editor), Chad E. Fogg
Course Code : CEN 557
Course Title : DIGITAL IMAGE PROCESSING

Level : Graduate
Year : Semester :
Status : Compulsory/Elective
Hours/Week : 3
Total Hours : 45

ECTS Credits : 7.5

Instructor :

COURSE DESCRIPTION
Digital Image Processing: Digital images, sampling and quantization of images, arithmetic operations, gray scale manipulations, distance measures, image compression techniques, connectivity, image transforms, enhancement, restoration, segmentation, representation and description

COURSE OBJECTIVES

COURSE CONTENTS
Introduction
Motivation: Why Image Processing?

II. Two-Dimensional System Theory
All that is the same (generalizations from 1-d to 2-d)
All that is the different
Quantization
Filter design
Optical image processing

III. Image Compression
Pixel and predictive coding
Transform coding
Image transforms (KLT, DCT, wavelets)

IV. Image Enhancement and Restoration
Point processing, histogram equalization
Spatial processing, linear and nonlinear
Inverse and Wiener filters

V. Image Analysis
Edge detection
Multiscale edge detection
Morphology

VI. Imaging Systems (as time permits)
Tomography
Synthetic aperture radar
Magnetic resonance

TEACHING/ASSESSMENT

Teaching Methods
1. Interactive lectures and communications with students
2. Discussions and group works
3. Presentations (4-5 students per semester)

Description

Student Assessment Methods
Homework
Actively Participation
Project
Midterm Examination
Final Examination

Description (%)
10%
10%
20%
20%
40%

Learning outcomes
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<tr>
<td>Textbook(s)</td>
<td></td>
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<tr>
<td></td>
<td>J. S. Lim, Two-Dimensional Signal and Image Processing, Prentice-Hall, 1990</td>
</tr>
<tr>
<td></td>
<td>R. C. Gonzalez and R. E. Woods, Digital Image Processing, Addison-Wesley 1993</td>
</tr>
<tr>
<td>COURSE DESCRIPTION</td>
<td>COURSE OBJECTIVES</td>
</tr>
<tr>
<td>--------------------</td>
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</tr>
<tr>
<td>Image formation, image processing for feature detection, object recognition and representation, motion analysis, simple motion estimation problems, stereo vision, camera models and projections.</td>
<td>Learning outcomes</td>
</tr>
<tr>
<td><strong>COURSE CONTENTS</strong></td>
<td>• Demonstrate a systematic and critical understanding of the theories, principles and practices of computing;</td>
</tr>
<tr>
<td>Introduction</td>
<td>• Critically review the role of a &quot;professional computing practitioner&quot; with particular regard to an understanding of legal and ethical issues;</td>
</tr>
<tr>
<td>Machine learning</td>
<td>• Creatively apply contemporary theories, processes and tools in the development and evaluation of solutions to problems and product design;</td>
</tr>
<tr>
<td>Pattern classification</td>
<td>• Actively participate in, reflect upon, and take responsibility for, personal learning and development, within a framework of lifelong learning and continued professional development;</td>
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<tr>
<td>Segmentation</td>
<td>• Present issues and solutions in appropriate form to communicate effectively with peers and clients from specialist and non-specialist backgrounds;</td>
</tr>
<tr>
<td>Design examples / MATLAB</td>
<td>• Work with minimum supervision, both individually and as a part of a team, demonstrating the interpersonal, organisation and problem-solving skills supported by related attitudes necessary to undertake employment.</td>
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</tbody>
</table>
| Design examples / .NET | Language of Instruction  
| **TEACHING/ASSESSMENT** | English |
| Teaching Methods | Textbook(s)  
| Description | **Comment [AS1]:** reference |
| 1. Interactive lectures and communications with students |  
2. Discussions and group works  
3. Presentations(4-5 students per semester)  
Description(%)  
| Description(%) |  
Homework | 10% |
<p>| Actively Participation | 10% |
| Project | 20% |
| Midterm Examination | 20% |
| Final Examination | 40% |</p>
<table>
<thead>
<tr>
<th>Course Code : CEN 559</th>
<th>Course Title : MACHINE LEARNING</th>
</tr>
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<tbody>
<tr>
<td>Level : Graduate</td>
<td>Year :</td>
</tr>
<tr>
<td>Status : Compulsory/Elective</td>
<td>Hours/Week :</td>
</tr>
<tr>
<td>Instructor :</td>
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</table>

**COURSE DESCRIPTION**

Machine learning techniques and statistical pattern recognition, supervised learning (generative/discriminative learning, parametric/non-parametric learning, neural networks, support vector machines); unsupervised learning (clustering, dimensionality reduction, kernel methods); learning theory (bias/variance tradeoffs; VC theory; large margins); reinforcement learning and adaptive control, applications areas (robotic control, data mining, autonomous navigation, bioinformatics, speech recognition, and text and web data processing).

**COURSE OBJECTIVES**

Present the key algorithms and theory that form the core of machine learning. Draw on concepts and results from many fields, including statistics, artificial intelligence, philosophy, information theory, biology, cognitive science, computational complexity, and control theory.

**COURSE CONTENTS**

- Introduction
- Concept Learning
- Decision Tree Learning
- Artificial Neural Networks
- Evaluation Hypotheses
- Bayesian Learning
- Computational Learning Theory
- Reinforcement Learning

**TEACHING/ASSESSMENT**

<table>
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**Learning outcomes**

- Demonstrate a systematic and critical understanding of the theories, principles and practices of computing;
- Creatively apply contemporary theories, processes and tools in the development and evaluation of solutions to problems in machine learning;
- Actively participate in, reflect upon, and take responsibility for, personal learning and development, within a framework of lifelong learning and continued professional development;
- Present issues and solutions in appropriate form to communicate effectively with peers and clients from specialist and non-specialist backgrounds;
- Work with minimum supervision, both individually and as a part of a team, demonstrating the interpersonal, organisation and problem-solving skills supported by related attitudes necessary to undertake employment.

**Language of Instruction**

English

**Textbook(s)**

**Course Code:** CEN 561  
**Course Title:** DECISION SUPPORT SYSTEMS  
**Level:** Graduate  
**Year:**  
**Semester:**  
**ECTS Credits:** 7.5  
**Status:** Compulsory/Elective  
**Hours/Week:** 3  
**Total Hours:** 45  

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**COURSE DESCRIPTION**  
This course focuses on design, development and implementation of effective systems for meeting information needs of management decision-makers. The course explains both model-based and data-based decision support systems and their use by managers in functional areas. Spreadsheets and applied artificial intelligence models, such as artificial neural network, and/or rule-based expert systems software may be used to introduce the decision-support process.

**COURSE OBJECTIVES**  
This course focuses on design, development and implementation of effective systems for meeting information needs of management decision-makers. The course explains both model-based and data-based decision support systems and their use by managers in functional areas. Spreadsheets and applied artificial intelligence models, such as artificial neural network, and/or rule-based expert systems software may be used to introduce the decision-support process.

**COURSE CONTENTS**

**TEACHING/ASSESSMENT**

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<td>Final Examination</td>
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</table>

**Learning outcomes**

- Demonstrate a systematic and critical understanding of the theories, principles and practices of computing;
- Critically review the role of a “professional computing practitioner” with particular regard to an understanding of legal and ethical issues;
- Creatively apply contemporary theories, processes and tools in the development and evaluation of solutions to problems and product design;
- Actively participate in, reflect upon, and take responsibility for, personal learning and development, within a framework of lifelong learning and continued professional development;
- Present issues and solutions in appropriate form to communicate effectively with peers and clients from specialist and non-specialist backgrounds;
- Work with minimum supervision, both individually and as a part of a team, demonstrating the interpersonal, organisation and problem-solving skills supported by related attitudes necessary to undertake employment.

**Language of Instruction**  
English  

**Textbook(s)**
**Course Code:** CEN 563  
**Course Title:** NETWORK PROGRAMMING

<table>
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| Instructor: |

**COURSE DESCRIPTION**
Design and implementation of network programs, protocols and systems: Network programming models, concurrency and concurrent programming, advanced socket programming, distributed computing, message-oriented middleware, peer-to-peer programming, mobile agents, multimedia networking, introduction to enterprise applications development.

**COURSE OBJECTIVES**

**COURSE CONTENTS**
- Intro. To Networking,
- O.S.I. Reference Model
- Datalink and Transport Layers,
- Ethernet, TCP/IP
- Sockets Programming
- TCP Programming
- TELNET, HTTP, Authd
- UDP sockets
- I/O Multiplexing
- TFTP
- DNS and address conversion
- Buffer Overflow
- The WWW & Web Programming (CGI)
- Cookies, JavaScript, XML Handouts, Links
- Router and Bridge Software
- Threads programming
- IPV6
- Client/Server Programming
- Advanced Sockets Programming
- SMTP, POP, IMAP, FTP
- More Internet Application Protocols
- Protocol Design
- SCTP
- Security
- LDAP
- XDR
- RPC Programming

**TEACHING/ASSESSMENT**

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**Learning outcomes**
- Demonstrate a systematic and critical understanding of the theories, principles and practices of computing;
- Critically review the role of a “professional computing practitioner” with particular regard to an understanding of legal and ethical issues;
Creatively apply contemporary theories, processes and tools in the development and evaluation of solutions to problems and product design;
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**Course Description**

This course covers abstractions and implementation techniques for the design of distributed systems. Topics include: server design, network programming, naming, storage systems, security, and fault tolerance. The assigned readings for the course are from current literature.

**Course Objectives**

**Course Contents**

- Introduction to Distributed Systems, Introduction to Erlang
- System Architecture, Communication
- Mid-session Recess
- Replication & Consistency, Distributed Shared Memory
- Synchronisation & Coordination
- Synchronisation & Coordination
- Middleware
- Fault Tolerance
- Security
- Naming, Distributed File Systems
- Parallel Programming, Clusters and Grid
- Research issues
- Review

**Teaching/Assessment**

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**Learning Outcomes**

- Demonstrate a systematic and critical understanding of the theories, principles and practices of computing;
- Critically review the role of a "professional computing practitioner" with particular regard to an understanding of legal and ethical issues;
- Creatively apply contemporary theories, processes and tools in the development and evaluation of solutions to problems and product design;
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**Language of Instruction**

- English

**Textbook(s)**

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**COURSE DESCRIPTION**
Wireless transmission (physical layer), wireless media access (link layer), telecommunication systems (such as GSM/GPRS, DECT, TETRA, UMTS and IMT-2000), wireless LANs (IEEE 802.11, Bluetooth), mobile network layer (mobile IP, DHCP), mobile transport layer (TCP over wireless), mobile application support and wireless programming.

**COURSE OBJECTIVES**

**COURSE CONTENTS**

- Introduction
- Wireless transmission (physical layer) (1/2)
- Wireless transmission (physical layer) (2/2)
- Wireless media access (link layer) (1/2)
- Wireless media access (link layer) (2/2)
- Wireless telecommunication systems: GSM/GPRS, EDGE, UMTS
- Wireless LANs: IEEE 802.11
- Wireless LANs: Bluetooth
- Mobile network layer (mobile IP, DHCP, mobile ad-hoc networks)
- Mobile transport layer (TCP over wireless)
- Mobile application support and introduction to wireless programming
- Wireless sensor networks

**TEACHING/ASSESSMENT**

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**Learning outcomes**
Demonstrate a systematic and critical understanding of the theories, principles and practices of computing; Critically review the role of a "professional computing practitioner" with particular regard to an understanding of legal and ethical issues; Creatively apply contemporary theories, processes and tools in the development and evaluation of solutions to problems and product design; Actively participate in, reflect upon, and take responsibility for, personal learning and development, within a framework of lifelong learning and continued professional development; Present issues and solutions in appropriate form to communicate effectively with peers and clients from specialist and non-specialist backgrounds; Work with minimum supervision, both individually and as a part of a team, demonstrating the interpersonal, organisation and problem-solving skills supported by related attitudes necessary to undertake employment.

**Language of Instruction**
English

**Textbook(s)**
- Schiller J., 1999, Mobile Communications, Addison Wesley
**Course Code:** CEN 567  
**Course Title:** Project Management in Software Engineering

<table>
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**Status:** Compulsory/Elective  
**Hours/Week:** 3  
**Total Hours:** 45

**COURSE DESCRIPTION**  
Project management in software engineering provides an overview of the roles, responsibilities, and management methods of the technology project manager. The course assumes no prior knowledge in management techniques and is intended to teach students how to develop approaches and styles of management for software projects. The course assumes a basic understanding of analysis techniques.

**COURSE OBJECTIVES**

A. To provide students with a clear understanding of the unique risks, issues, and critical success factors associated with technology projects  
B. To introduce students to the role and function of project management  
C. To explain the stages and process of the project life cycle  
D. To understand the various techniques for planning and managing a technology project  
E. To examine basic methodologies for software design, development, testing and implementation  
F. To examine various techniques for managing a software development team  
G. To understand the need and techniques for managing users and user expectations  
H. To learn project planning techniques through the use of Microsoft Project

**COURSE CONTENTS**

**Course Overview**
- Course Introduction  
- Project Management (PM) Fundamentals  
- The PM field and job market  
- People, Process, Product, Technology  
- 36 Classic Mistakes

**Overview of Project Management**
- PMI Processes  
- Software project phases  
- Organizational structures  
- Project charter  
- Statement of Work (SOW)

**Planning Phase**
- Development lifecycle models  
- Matching lifecycles to projects  
- Project plans  
- Work Breakdown Structures (WBS)

**Estimation and Budgeting**
- Estimation  
- Budgeting  
- Project selection  
- NPV, ROI, Payback models

**Scheduling**
- Project network diagram fundamentals  
- PERT techniques  
- Gantt charts  
- Critical chain scheduling  
- Mid-term preview

**Risk and Change Management**
- Mid-term review  
- Risk management  
- Change control  
- More MS-Project

**Development Management**
- Team models  
- Requirements process  
- Configuration management
- Software metrics
- Programming languages & tools
- Managing conflict and motivating
- MS-Project: Assigning Resources

**Project Control**
- Status reporting
- Project metrics
- Earned value analysis
- Communications Techniques
- Process Improvement
- MS Project:
  - (a) Resource leveling
  - (b) Other views

**System Test Process**
- Test specifications
- Black box and white box testing
- Test scripts
- Unit and integration testing
- Acceptance test specifications
- Test tools
- MS Project:
  - (a) Reporting

**Final Phases & Other Issues**
- Project Recovery
- Documentation
- Cutover/Migration
- Post Project Reviews
- Closing
- MS Project:
  - (a) Advanced features

**Project Success**
- Management support
- Expectations
- Success metrics
- Final exam review

### TEACHING/ASSESSMENT

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<td>Course Code : CEN 573</td>
<td>Course Title : ADVANCED BIOINFORMATICS</td>
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**COURSE DESCRIPTION**
The course is designed to introduce the advanced concepts, methods, and tools used in Bioinformatics. Bioinformatics stands at the interface of molecular biology and information sciences and promises to provide critical tools for managing the immense volume of biological data. The bioinformatics market primarily is driven by the need of agricultural, pharmaceutical and medical biotechnological companies to increase the efficiency of their discovery and development of new crop varieties, pharmaceutical drugs and other relevant products. The pharmaceutical companies use bioinformatics to identify drug targets and drug candidates, decreasing the time to bring new therapeutics to market. Emphasis will be put on the understanding and utilization of these concepts and algorithms. The objective is to help the students to reach rapidly the frontier of bioinformatics and be able to use the bioinformatics tools to solve the problems on their own research.

**COURSE OBJECTIVES**
The objective of this course is to train the students in software application development, mathematics, statistics, cell & molecular biology, and other bioinformatics tools like SAS (Statistical Analytical System). Emphasis would be laid on understanding scientific databases & algorithms, sequence analysis and programming in various languages applicable to modern biology. The course includes an integrated project which involves the application of the above aspects.

**COURSE CONTENTS**
Advanced Bioinformatics equips the student with the interdisciplinary knowledge and skills necessary to meet the data-centred challenges of modern-day biology. Effective methods and algorithms for uncovering patterns in genomic data of different forms are discussed, and in several cases developed and applied to representative problems. The course has three over-arching themes each supported by lectures and project-based work: (1) Biological sequence data and their analysis, (2) Biological structure and discovering functional features, and (3) Systems biology, phylogeny and models of evolution.

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**Learning outcomes**
- Evaluate basic theories, processes and outcomes of computing;
- Apply bioinformatics and biological techniques and relevant tools to the specification, analysis, design, implementation and testing of a simple computing product. For example identification of genes involved in specific biological process in the cell.
- Knowledge and critical understanding of the well-established principles of bioinformatics, and of the way in which those principles have developed as technology has progressed
- Knowledge of all of the main development methods relevant to the field of computing, and ability to evaluate critically the appropriateness of different approaches to solving problems in the field of genetics and genetic engineering.

**Language of Instruction**
English

**Textbook(s)**
Bioinformatics – A practical approach by Shui Qing He 2008, Chapman and Hall/CRC
The course is designed to introduce the advanced concepts, methods, and tools used in Bioinformatics. Bioinformatics stands at the interface of molecular biology and information sciences and promises to provide critical tools for managing the immense volume of biological data. The bioinformatics market primarily is driven by the need of agricultural, pharmaceutical and medical biotechnological companies to increase the efficiency of their discovery and development of new crop varieties, pharmaceutical drugs and other relevant products. The pharmaceutical companies use bioinformatics to identify drug targets and drug candidates, decreasing the time to bring new therapeutics to market. Emphasis will be put on the understanding and utilization of these concepts and algorithms. The objective is to help the students to reach rapidly the frontier of bioinformatics and be able to use the bioinformatics tools to solve the problems on their own research.

The objective of this course is to train the students in software application development, mathematics, statistics, cell & molecular biology, and other bioinformatics tools like SAS (Statistical Analytical System). Emphasis would be laid on understanding scientific databases & algorithms, sequence analysis and programming in various languages applicable to modern biology. The course includes an integrated project which involves the application of the above aspects.

Advanced Bioinformatics equips the student with the interdisciplinary knowledge and skills necessary to meet the data-centred challenges of modern-day biology. Effective methods and algorithms for uncovering patterns in genomic data of different forms are discussed, and in several cases developed and applied to representative problems. The course has three over-arching themes each supported by lectures and project-based work: (1) Biological sequence data and their analysis, (2) Biological structure and discovering functional features, and (3) Systems biology, phylogeny and models of evolution.

1. Interactive lectures and communication with students
2. Discussions and group work
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4. Tutorials

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- Knowledge and critical understanding of the well-established principles of bioinformatics, and of the way in which those principles have developed as technology has progressed.
- Knowledge of all of the main development methods relevant to the field of computing, and ability to evaluate critically the appropriateness of different approaches to solving problems in the field of genetics and genetic engineering.

Language of Instruction: English

Textbook(s): Bioinformatics – A practical approach by Shui Qing He 2008, Chapman and Hall/CRC
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Instructor:

**COURSE DESCRIPTION**
To provide basics about the computational problems in the emerging areas Bioinformatics, Computational Biology, and Genomics to the students having varied backgrounds of engineering, computer science, and the life sciences. The course is aimed at training these students in computational to work in the area of bioinformatics and computational biology.

**COURSE OBJECTIVES**
The objective of this course is to train the students in computational methods in cell & molecular biology, and bioinformatics. Emphasis would be laid on understanding basic tools & algorithms in different areas of bioinformatics. The course includes an integrated project which involves the application of the above aspects.

**COURSE CONTENTS**
Bioinformatics Tools and databases for Molecular and Genome Analyses will be taught in detail. In this connection following topics will be covered:
DNA sequence analysis, promoter analysis and identification of transcription factor binding sites; methods for the unsupervised analysis, validation and visualization of structures discovered in bio-molecular data -- prediction of secondary and tertiary protein structures; gene expression data analysis; mathematical modelling and simulation of biological systems

**TEACHING/ASSESSMENT**

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<td>1. Interactive lectures and communication with students</td>
</tr>
<tr>
<td>2. Discussions and group work</td>
</tr>
<tr>
<td>3. Presentations</td>
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<tr>
<td>4. Tutorials</td>
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**Description(%)**

<table>
<thead>
<tr>
<th>Student Assessment Methods</th>
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<tbody>
<tr>
<td>Quizzes, Assignments 30%</td>
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<tr>
<td>Midterm Examination 30%</td>
</tr>
<tr>
<td>Final Examination 40%</td>
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</tbody>
</table>

**Learning outcomes**
- Evaluate basic theories, processes and outcomes of computing;
- Apply bioinformatics and biological techniques and relevant tools to the specification, analysis, design, implementation and testing of a simple computing product. For example identification of genes involved in specific biological process in the cell.
- Knowledge and critical understanding of the well-established principles of bioinformatics, and of the way in which those principles have developed as technology has progressed
- Knowledge of all of the main development methods relevant to the field of computing, and ability to evaluate critically the appropriateness of different approaches to solving problems in the field of genetics and genetic engineering.

**Language of Instruction**
English

**Textbook(s)**
### COURSE DESCRIPTION
In this course, the focus is on computer graphics techniques for the generation of realistic images using techniques for defining surfaces and for calculating lighting and shading effects. Students will write programs to render 3D objects using techniques ranging from simple flat shading to complex ray-shading. User-interface design with X-windows will be introduced. We will also briefly discuss programming with the OpenGL graphics library and Java.

### COURSE OBJECTIVES
- Graphics basics
- Introduction
- Graphics programming & OpenGL
- Transformations
- Hierarchical modeling
- Viewing
- Scan conversion
- Modeling
- Polygonal meshes
- Rendering
- Rendering concepts
- Hidden surface removal
- Illumination and shading
- Texture mapping
- Programmable shaders
- Curves & surfaces
- Animation
- Key-frame animation
- Advanced rendering
- Ray tracing & Radiosity
- Non-photorealistic rendering
- Summary
- Advanced modeling (self-study)
- Multi-resolution meshes
- Subdivision meshes

### COURSE CONTENTS

### TEACHING/ASSESSMENT

<table>
<thead>
<tr>
<th>Teaching Methods</th>
<th>Description</th>
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<tbody>
<tr>
<td>1. Interactive lectures and communications with students</td>
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<tr>
<td>2. Discussions and group works</td>
<td></td>
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<tr>
<td>3. Presentations(4-5 students per semester)</td>
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<tr>
<th>Student Assessment Methods</th>
<th>Description(%)</th>
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<tbody>
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<td>Homework</td>
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<tr>
<td>Actively Participation</td>
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<tr>
<td>Project</td>
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<td>Midterm Examination</td>
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<tr>
<td>Final Examination</td>
<td>40%</td>
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</table>

Learning outcomes:
- Demonstrate a systematic and critical understanding of the theories, principles and practices of computing;
- Critically review the role of a "professional computing practitioner" with particular regard to an understanding of legal and ethical issues;
- Creatively apply contemporary theories, processes and tools in the development and evaluation of solutions to problems and product design;
Actively participate in, reflect upon, and take responsibility for, personal learning and development, within a framework of lifelong learning and continued professional development;
Present issues and solutions in appropriate form to communicate effectively with peers and clients from specialist and non-specialist backgrounds;
Work with minimum supervision, both individually and as a part of a team, demonstrating the interpersonal, organisation and problem-solving skills supported by related attitudes necessary to undertake employment.

<table>
<thead>
<tr>
<th>Language of Instruction</th>
<th>English</th>
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**Course Code:** CEN 582  
**Course Title:** COMPUTER AND NETWORK SECURITY

<table>
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<th>Level</th>
<th>Year</th>
<th>Semester</th>
<th>ECTS Credits</th>
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<tbody>
<tr>
<td>Compulsory/Elective</td>
<td>3</td>
<td>45</td>
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</table>

**Instructor:**

**COURSE DESCRIPTION**

Techniques for achieving security in multi-user computer systems and distributed computer systems: Basics of cryptography, network security applications and system security, conventional encryption and message confidentiality, public-key cryptography and message authentication, authentication applications. Electronic mail, IP, web, and network management security. Intruders, viruses, and firewalls.

**COURSE OBJECTIVES**

- Introduce computer and network security concepts.
- Introduce confidentiality, integrity and availability
- Develop some general design decisions that should be made when constructing secure systems
- Develop basic application of information security concepts.

**COURSE CONTENTS**

- Introduction to Computer and Network Security
- Cryptographic Tools
- User Authentication
- Access Control
- Database Security
- Intrusion Detection
- Malicious Software
- Denial of Service
- Firewalls and Intrusion Prevention
- Trusted Computing and Multilevel Security
- Buffer Overflow
- Other Software Security Issues
- Physical and Infrastructure Security
- Human Factors
- Security Auditing
- IT Security Management and Risk Assessment
- IT Security Controls, Plans and Procedures
- Legal and Ethical Aspects
- Symmetric Encryption and Message Confidentiality
- Public-Key Cryptography and Message Authentication
- Internet Security Protocols and Standards
- Internet Authentication Applications
- Unix/Linux Security
- Windows and Windows Vista Security

**TEACHING/ASSESSMENT**

<table>
<thead>
<tr>
<th>Teaching Methods</th>
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</table>
| 1. Interactive lectures and communications with students  
2. Discussions and group works  
3. Presentations (4-5 students per semester) | |

<table>
<thead>
<tr>
<th>Student Assessment Methods</th>
<th>Description(%)</th>
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</table>
| Homework  
Actively Participation  
Project  
Midterm Examination  
Final Examination | 10%  
10%  
20%  
20%  
40% |

| Learning outcomes | Demonstrate a systematic and critical understanding of the theories, principles and practices of computing;  
Critically review the role of a "professional computing practitioner" with particular regard to an |
understanding of legal and ethical issues;
Creatively apply contemporary theories, processes and tools in the development and evaluation of solutions to problems and product design;
Actively participate in, reflect upon, and take responsibility for, personal learning and development, within a framework of lifelong learning and continued professional development;
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Work with minimum supervision, both individually and as a part of a team, demonstrating the interpersonal, organisation and problem-solving skills supported by related attitudes necessary to undertake employment.

<table>
<thead>
<tr>
<th>Language of Instruction</th>
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### Course Code : CEN 583  
Course Title : PARALLEL COMPUTER ARCHITECTURE  
Level : Graduate  
Year :  
Semester :  
ECTS Credits : 7.5  
Status : Compulsory/Elective  
Hours/Week : 3  
Total Hours : 45  
Instructor :

<table>
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<tr>
<th>COURSE DESCRIPTION</th>
<th>Reduced Instruction Set Computer (RISC) architecture, pipelined processor design (instruction and arithmetic pipelines), multiprocessor and alternative architectures, dynamic and static interconnection networks, shared memory multiprocessor systems, message passing multiprocessor systems and parallel processing.</th>
</tr>
</thead>
</table>

| COURSE OBJECTIVES | The General Purpose Machine  
Machines, Machine Languages, and Digital Logic  
Some Real Machines  
Processor Design  
Processor Design—Advanced Topics  
Computer Arithmetic and the Arithmetic Unit  
Memory System Design  
Input and Output  
Peripheral Devices |
|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

| COURSE CONTENTS | The General Purpose Machine  
Machines, Machine Languages, and Digital Logic  
Some Real Machines  
Processor Design  
Processor Design—Advanced Topics  
Computer Arithmetic and the Arithmetic Unit  
Memory System Design  
Input and Output  
Peripheral Devices |
|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

| TEACHING/ASSESSMENT | Description  
Teaching Methods  
1. Interactive lectures and communications with students  
2. Discussions and group works  
3. Presentations(4-5 students per semester) |
|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

| Student Assessment Methods | Homework  
Actively Participation  
Project  
Midterm Examination  
Final Examination |
|-----------------------------|-----------------|-----------------|-----------------|-----------------|
| Description(%) | 10%  
10%  
20%  
20%  
40% |

| Learning outcomes | Demonstrate a systematic and critical understanding of the theories, principles and practices of computing;  
Critically review the role of a "professional computing practitioner" with particular regard to an understanding of legal and ethical issues;  
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|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

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<tr>
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| Textbook(s) | Huering and Jordan, "Computer Systems Design and Architecture, 2/e"  
Additional References  
1."Computer Organization and Design, 2/e", Patterson & Hennessy, Morgan Kaufmann  
|----------------|--------------------------------------------------------------------------------------------------|


**Course Code:** CEN 584  
**Course Title:** EMBEDDED SYSTEMS

<table>
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<th>Level</th>
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<tr>
<td>Compulsory/Elective</td>
<td>3</td>
<td>45</td>
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**Instructor:**

**COURSE DESCRIPTION**
This is practically-orientated and advanced course in the area of electronics design and applications. It is distinctive in that it provides a strong digital technology core backed up with applications-led modules. Examples of these applications include medical and electronics, e-health, intelligent building design, automotive electronics, retail and commerce. Another feature of the course is the substantial amounts of practical work, giving students the confidence with software and digital hardware implementations using microcontrollers or general system-on-chip the methodology.

**COURSE OBJECTIVES**

**COURSE CONTENTS**
- **Embedded Microcontrollers:** Choosing and using microcontrollers for embedded system design.
- **Actuators and interfacing:** Pulse Width Modulation (PWM). DC motors. Amplifiers. Programming with actuators.
- **Basic control theory:** Principles of feedback, logic control and finite state machines. Software architectures for implementing controllers.
- **Communication protocols:** Communicating between multiple microcontrollers. RS232, I2C, CAN protocols. Designing distributed applications.

**TEACHING/ASSESSMENT**

**Teaching Methods**
1. Interactive lectures and communications with students
2. Discussions and group works
3. Presentations (4-5 students per semester)

**Student Assessment Methods**

<table>
<thead>
<tr>
<th>Description (%)</th>
<th>Homework</th>
<th>Actively Participation</th>
<th>Project</th>
<th>Midterm Examination</th>
<th>Final Examination</th>
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<td>10%</td>
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<td>20%</td>
<td>20%</td>
<td>40%</td>
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</table>

**Learning outcomes**
- Demonstrate a systematic and critical understanding of the theories, principles and practices of computing;
- Critically review the role of a “professional computing practitioner” with particular regard to an understanding of legal and ethical issues;
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- Work with minimum supervision, both individually and as a part of a team, demonstrating the interpersonal, organisation and problem-solving skills supported by related attitudes necessary to undertake employment.

**Language of Instruction:** English

**Textbook(s)**
Programming and Interfacing the 8051, S.Yeralan, A. Ahluwalia, 1995 Addison Wesley
| Programming and Customizing the 8051 Microcontroller, Myke Predko, 1999, Mc Graw Hill |

**Additional References**
- www.atmel.com.tr
Course Code : CEN 585  
Course Title : ADVANCED COMPUTER NETWORKS

Level : Graduate  
Year :  
Semester :  
ECTS Credits : 7.5

Status : Compulsory/Elective  
Hours/Week : 3  
Total Hours : 45

Instructor :  

**COURSE DESCRIPTION**

This course introduces the basics of computer networking. Students will develop an understanding of the general principles of computer networks. Specific attention will be given to the principles of network architecture and layering, multiplexing, network addressing, routing and routing protocols. Activities include setting up a local area network, the Internet, security, network management and network performance analysis.

**COURSE OBJECTIVES**

The goal of this course is that the student will develop an understanding of the underlying structure of networks and how they operate. At the end of this course a student should be able to:

1. Explain basic networking concepts by studying client/server architecture, network scalability, geographical scope, the Internet, intranets and extranets.
2. Identify, describe and give examples of the networking applications used in everyday tasks such as reading email or surfing the web.
3. Describe layered communication, the process of encapsulation, and message routing in network equipped devices using appropriate protocols.
4. Design and build an Ethernet network by designing the subnet structure and configuring the routers to service that network.
5. Manage network management and systems administration.
6. Construct a patch cord to connect a host computer to a network.

**COURSE CONTENTS**

Basics of data transmission, data communication services (SMDS, X.25, FR, ISDN, ATM, BISDN), definition uses classification and topologies of computer networks, multiple access methods, layered network structure. OSI and TCP/IP reference models, example networks, network standardization, physical layer, types of transmission medium, X.21, ISDN and V.35, interfaces, functions of data link layer, framing, flow control, error control, HDLC, SLIP and PPP Protocols, medium access control (MAC) sublayer, repeaters, bridges, LAN switches, routers, layer-3 switches and gateways, Networking and internetworking principles; Internet routing, congestion control and operation. Local area networks: Topologies, medium access under contention, queuing principles, performance evaluation, network management, message handling systems, www, multimedia applications, multimedia, coding, compression, security, directory services.

**TEACHING/ASSESSMENT**

<table>
<thead>
<tr>
<th>Teaching Methods</th>
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<tbody>
<tr>
<td>1. Interactive lectures</td>
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<tr>
<td>2. Discussions and group</td>
<td>students</td>
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<tr>
<td>3. Presentations(4-5</td>
<td>students per semester)</td>
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<th>Student Assessment Methods</th>
<th>Description (%)</th>
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<tr>
<td>Research Project</td>
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<td>Midterm Examination</td>
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<td>Final Examination</td>
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<table>
<thead>
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<th>Learning outcomes</th>
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<tbody>
<tr>
<td></td>
<td>Demonstrate a systematic and critical understanding of</td>
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<tr>
<td></td>
<td>the theories, principles and practices of computing;</td>
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<td></td>
<td>Critically review the role of a “professional computing</td>
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<td>practitioner” with particular regard to an understanding</td>
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<td>of legal and ethical issues;</td>
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<td></td>
<td>Creatively apply contemporary theories, processes and</td>
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<td>Actively participate in, reflect upon, and take</td>
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<td>responsibility for, personal learning and development,</td>
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<td>professional development;</td>
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Present issues and solutions in appropriate form to communicate effectively with peers and clients from specialist and non-specialist backgrounds;
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<td>Course Code</td>
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<tr>
<td>CEN 590</td>
<td>ARTIFICIAL INTELLIGENCE</td>
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<th>Semester</th>
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<td>45</td>
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<tr>
<th>Instructor</th>
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### COURSE DESCRIPTION
This course introduces representations, techniques, and architectures used to build applied systems and to account for intelligence from a computational point of view. This course also explores applications of rule chaining, heuristic search, logic, constraint propagation, constrained search, and other problem-solving paradigms. In addition, it covers applications of decision trees, neural nets, SVMs and other learning paradigms.

### COURSE OBJECTIVES

### COURSE CONTENTS
- Search Algorithms
- Graph Search
- Constraint Satisfaction
- Games
- Machine Learning
- Nearest Neighbors
- Decision Trees
- Neural Networks
- SVM
- Knowledge Representation and Inference (5 weeks)
- Propositional and First Order Logic
- Rule-based Systems
- Natural Language

### TEACHING/ASSESSMENT

<table>
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<tbody>
<tr>
<td>1. Interactive lectures and communications with students</td>
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<table>
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<tr>
<th>Description(%)</th>
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<tbody>
<tr>
<td>Homework 10%</td>
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<tr>
<td>Actively Participation 10%</td>
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<tr>
<td>Project 20%</td>
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<tr>
<td>Midterm Examination 20%</td>
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<tr>
<td>Final Examination 40%</td>
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### Language of Instruction
English

### Textbook(s)

### Additional References
http://airesources.blogspot.com/
http://archive.comlab.ox.ac.uk/complai.html
http://www.dmoz.org/Computers/Artificial_Intelligence
## Course Description
This course explores the organization of synaptic connectivity as the basis of neural computation and learning. Perceptrons and dynamical theories of recurrent networks including amplifiers, attractors, and hybrid computation are covered. Additional topics include backpropagation and Hebbian learning, as well as models of perception, motor control, memory, and neural development.

## Course Objectives

### COURSE CONTENTS
- Perceptrons: Simple and Multilayer
- Perceptrons as Models of Vision
- Linear Networks
- Retina
- Lateral Inhibition and Feature Selectivity
- Objectives and Optimization
- Hybrid Analog-Digital Computation
- Ring Network
- Constraint Satisfaction
- Stereopsis
- Bidirectional Perception
- Signal Reconstruction
- Hamiltonian Dynamics
- Antisymmetric Networks
- Excitatory-Inhibitory Networks
- Learning
- Associative Memory
- Models of Delay Activity
- Integrators
- Multistability
- Clustering
- VQ, PCA
- Delta Rule
- Conditioning
- Backpropagation
- Stochastic Gradient Descent
- Reinforcement Learning

---

## Teaching/Assessment

### Description

1. Interactive lectures and communications with students
2. Discussions and group works
3. Presentations (4-5 students per semester)

### Description(%)  
- Homework: 10%
- Actively Participation: 10%
- Project: 20%
- Midterm Examination: 20%
- Final Examination: 40%

### Learning outcomes
- Demonstrate a systematic and critical understanding of the theories, principles and practices of computing;
- Critically review the role of a "professional computing practitioner" with particular regard to an understanding of legal and ethical issues;
- Creatively apply contemporary theories, processes and tools in the development and evaluation of
solutions to problems and product design;
Actively participate in, reflect upon, and take responsibility for, personal learning and
development, within a framework of lifelong learning and continued professional development;
Present issues and solutions in appropriate form to communicate effectively with peers and clients
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Work with minimum supervision, both individually and as a part of a team, demonstrating the
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<th>English</th>
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<tbody>
<tr>
<td>Course Code : CEN 592</td>
<td>Course Title : PATTERN RECOGNITION</td>
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<tr>
<td>Level : Graduate</td>
<td>Year : Semester : ECTS Credits : 7.5</td>
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<tr>
<td>Status : Compulsory/Elective</td>
<td>Hours/Week : 3</td>
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<td>Instructor :</td>
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**COURSE DESCRIPTION**

This class deals with the fundamentals of characterizing and recognizing patterns and features of interest in numerical data. We discuss the basic tools and theory for signal understanding problems with applications to user modeling, affect recognition, speech recognition and understanding, computer vision, physiological analysis, and more. We also cover decision theory, statistical classification, maximum likelihood and Bayesian estimation, nonparametric methods, unsupervised learning and clustering. Additional topics on machine and human learning from active research are also talked about in the class.

**COURSE OBJECTIVES**

**COURSE CONTENTS**

- Introduction to statistical pattern recognition
- Bayesian decision theory
- Maximum likelihood and Bayesian parameter estimation
- Linear Classifiers, Nonlinear Classifiers
- Feature Selection and Extraction
- Parametric techniques, Nonparametric techniques
- Linear Discriminant Functions
- Tree Based Methods
- Multilayer Neural Networks
- Stochastic Methods
- Non-metric Methods
- Algorithm-independent machine learning
- Unsupervised Learning and Clustering

**TEACHING/ASSESSMENT**

<table>
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<tbody>
<tr>
<td>Project</td>
<td>30%</td>
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<td>Midterm Examination</td>
<td>30%</td>
</tr>
<tr>
<td>Final Examination</td>
<td>40%</td>
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</table>

**Learning outcomes**

- Demonstrate a systematic and critical understanding of the theories, principles and practices of computing;
- Critically review the role of a “professional computing practitioner” with particular regard to an understanding of legal and ethical issues;
- Creatively apply contemporary theories, processes and tools in the development and evaluation of solutions to problems and product design;
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- Work with minimum supervision, both individually and as a part of a team, demonstrating the interpersonal, organisation and problem-solving skills supported by related attitudes necessary to undertake employment.

**Language of Instruction**

English

**Textbook(s)**


Additional References
http://www.prtools.org/
http://ocw.mit.edu/OcwWeb/Media-Sciences/MAS-622JFall-2006/CourseHome/index.htm
# Course Description

The course provides basic knowledge of biologically inspired methods in computer science, such as genetic algorithms, genetic programming, and artificial life. These methods are both relevant to technical applications, for example, in optimization and design of autonomous systems, and for understanding biological systems, e.g., through simulation of evolutionary processes.

## Course Objectives

- Biological evolution: Introduction and basic properties
- Fundamentals of genetic algorithms: Representations, genetic operators, selection mechanisms
- Theory of genetic algorithms: The schema theorem and the onemax problem
- Different versions of evolutionary algorithms, with particular emphasis on genetic algorithms
- Computer program development (using Matlab) for evolutionary algorithms
- Experiment design (with emphasis on the use of evolutionary methods)
- Advanced topics: Boltzmann selection, messy encoding schemes, variable-structure encoding schemes
- Diffusion models, subpopulation-based evolutionary algorithms
- Applications of evolutionary algorithms: Function optimization, data mining,
- Evolving neural networks, scheduling, the traveling salesman problem,
- Interactive evolutionary algorithms

## Teaching/Assessment

### Teaching Methods

1. Interactive lectures and communications with students
2. Discussions and group works
3. Presentations (4-5 students per semester)

### Description

- Student Assessment Methods
- Learning outcomes
- Language of Instruction
- Textbook(s)
- Additional References

<table>
<thead>
<tr>
<th>Teaching Methods</th>
<th>Description</th>
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<tbody>
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<tr>
<td>Learning outcomes</td>
<td>Demonstrate a systematic and critical understanding of the theories, principles and practices of computing; Critically review the role of a &quot;professional computing practitioner&quot; with particular regard to an understanding of legal and ethical issues; Creatively apply contemporary theories, processes and tools in the development and evaluation of solutions to problems and product design; Actively participate in, reflect upon, and take responsibility for, personal learning and development, within a framework of lifelong learning and continued professional development; Present issues and solutions in appropriate form to communicate effectively with peers and clients from specialist and non-specialist backgrounds; Work with minimum supervision, both individually and as a part of a team, demonstrating the interpersonal, organisation and problem-solving skills supported by related attitudes necessary to undertake employment.</td>
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<tr>
<th>Language of Instruction</th>
<th>English</th>
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<tr>
<th>Textbook(s)</th>
<th>Description</th>
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**Course Code:** CEN 593  
**Course Title:** EVOLUTIONARY COMPUTING  
**Level:** Graduate  
**Year:**  
**Semester:**  
**ECTS Credits:** 7.5  
**Status:** Compulsory/Elective  
**Hours/Week:** 3  
**Total Hours:** 45
Course Code: CEN 595  
Course Title: SCIENTIFIC RESEARCH METHODS

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<tr>
<th>Status: Compulsory/Elective</th>
<th>Hours/Week: 3</th>
<th>Total Hours: 45</th>
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Instructor:

**COURSE DESCRIPTION**
Exploration of quantitative and qualitative research methods commonly used in communication studies.
This is an introductory course on research methods. The objectives of the course are to enable students to:
- Develop an understanding and an appreciation of the quantitative and qualitative research methods relevant to satisfactorily address a particular research question.
- Develop an understanding of the principles and processes involved in developing and addressing a specific research question.
- Develop core competencies in writing a research proposal.
- Develop a solid background in elementary statistics and data analysis.
- Acquire fundamental skills in the use of bibliographic software: EndNote or BibTeX.
- Acquire fundamental skills in the use of a Statistical Analysis Software: SPSS, or R.

**COURSE OBJECTIVES**

**COURSE CONTENTS**
- Problem identification
- Hypothesis formulation
- Sampling
- Research design
- Data collection and data collection strategies
- Validity, reliability and other measurement problems
- Data evaluation techniques and methods applied in management research
- Qualitative data analysis
- Non-parametric data analysis
- t-tests, ANOVA and MONOVA
- Correlation and canonical correlation analysis
- Factor analysis
- Research deontology
- Applications.

**TEACHING/ASSESSMENT**

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<tr>
<th>Student Assessment Methods</th>
<th>Description(%)</th>
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<tbody>
<tr>
<td>Homework</td>
<td>10%</td>
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<tr>
<td>Actively Participation</td>
<td>10%</td>
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<tr>
<td>Project</td>
<td>20%</td>
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<tr>
<td>Midterm Examination</td>
<td>20%</td>
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<tr>
<td>Final Examination</td>
<td>40%</td>
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**Learning outcomes**
Demonstrate a systematic and critical understanding of the theories, principles and practices of computing;
Critically review the role of a "professional computing practitioner" with particular regard to an understanding of legal and ethical issues;
Creatively apply contemporary theories, processes and tools in the development and evaluation of solutions to problems and product design;
Actively participate in, reflect upon, and take responsibility for, personal learning and development, within a framework of lifelong learning and continued professional development;
Present issues and solutions in appropriate form to communicate effectively with peers and clients from specialist and non-specialist backgrounds;
Work with minimum supervision, both individually and as a part of a team, demonstrating the interpersonal, organisation and problem-solving skills supported by related attitudes necessary to undertake employment.

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Additional References
1. Introductory Statistics with R by Peter Dalgaard
2. Data Manipulation with R by Phil Spector.
3. Discovering Statistics Using SPSS by Andy Field.
5. S. L. Jackson, Research methods and statistics : a critical thinking approach.
**Course Code**: BUS 501  
**Course Title**: FINANCIAL REPORTING AND ANALYSIS  
**Level**: Graduate  
**Year**:  
**Semester**: I-II  
**ECTS Credits**: 7.5  
**Status**: Elective  
**Hours/Week**: 3  
**Total Hours**: 45  
**Course Coordinator**:  

### COURSE DESCRIPTION
This course focuses on the analysis of managers’ financial reporting and disclosure strategies, and the effects of such strategies on firms’ equity values and contracts. We will examine various institutional settings and economic contexts in which managers make financial reporting and disclosure choices, paying close attention to the quality and credibility of the information disclosed.

### COURSE OBJECTIVES
The course should continue with developing skills of financial statement analysis.

### COURSE CONTENTS
- Revenue and Expense Recognition, Complex issues in revenue recognition.
- Issues related to Assets.
- Accounts receivable, Inventories, Investment property.
- Long-lived fixed assets, Intangible assets.
- Liabilities and equity.
- Deferred expenses, Financing liabilities, Leases, Special purpose entities
- Financial derivatives and hedging
- Critically analyze the financial statements
- Understanding of international financial reporting standards and international harmonization issues

### TEACHING/ASSESSMENT

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<tbody>
<tr>
<td><strong>Teaching Methods</strong></td>
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</table>
| **Student Assessment Methods** | 1. Project 25%  
2. Midterm exam 25%  
3. Final exam 50% |

<table>
<thead>
<tr>
<th>Learning outcomes</th>
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<tbody>
<tr>
<td>Students will be able to:</td>
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<tr>
<td>- examine the economic and institutional setting for financial reporting,</td>
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<td>- understand why accounting choices matter and to whom</td>
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<td>- prepare and analyze financial statements.</td>
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<td>- to read, use, and interpret the statements and most importantly to understand how and why managers can utilize the flexibility in GAAP to manipulate the numbers for their own purposes.</td>
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### Language of Instruction
English

### Textbook(s)
Course Code : BUS 530  
COURSE TITLE: OPERATIONS MANAGEMENT

<table>
<thead>
<tr>
<th>Level : Graduate</th>
<th>Year :</th>
<th>Semester : I-II</th>
<th>ECTS Credits : 7.5</th>
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<tbody>
<tr>
<td>Status : Elective</td>
<td>Hours/Week : 3</td>
<td>Total Hours : 45</td>
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Course Coordinator :

COURSE DESCRIPTION:
This course is concerned with the theory and practice of monetary policy in the modern market economy.

COURSE OBJECTIVES:
This course is concerned with the theory and practice of monetary policy in the modern market economy. Topics covered include: the ability of the central bank to regulate the supply of money and credit conditions; factors affecting the demand for money; and the relationship between changes in the money supply and interest rates and the impact of changes in each of these on other economic variables.

COURSE CONTENTS:
- An Introduction to Money and the Financial System
- Money and the Payments System
- Financial Instruments, Financial Markets, and Financial Institutions
- Future Value, Present Value, and Interest Rates, Understanding Risk
- Bonds, Bond Prices, and the Determination of Interest Rates
- The Risk and Term Structure of Interest Rates
- Stocks, Stock Markets, and Market Efficiency
- Money Growth, Money Demand, and Monetary Policy
- Output, Inflation, and Monetary Policy, Understanding Business Cycles
- Monetary Policy and the Challenges Facing Central Bank, Targeting
- Interest Rate Targeting, Money Supply Targeting, Exchange Rate Targeting, Inflation Rate targeting

TEACHING/ASSESSMENT

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<tbody>
<tr>
<td>Teaching Methods</td>
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<tr>
<td>Lecturing, Presentation, Research, Discussion, Problem solving</td>
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<th>Description (%)</th>
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<tbody>
<tr>
<td>Student Assessment Methods</td>
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<tr>
<td>Mid-Term Exams, Quizzes, Homework problem sets, Assignment / Presentation % 50</td>
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<tr>
<td>Final exam 50%</td>
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Learning outcomes
1. Money, Inflation, and Interest. Students will learn the various monetary indicators (interest rates, inflation, etc.) that are mentioned everyday in the press and used daily by people everywhere. Students will learn to calculate these measures as well as their strengths and weaknesses.
2. Monetary Policy. Students will learn how monetary policy is implemented, both at the aggregate level (how the money supply is determined) and the institutional level.
3. Interesting Monetary Episodes. Students will learn to apply the knowledge gained in the class to interesting monetary episodes such as hyperinflation in Brazil in the 1980s.

Language of Instruction: English

Textbook(s)
**Course Code**: BUS 582  
**COURSE TITLE**: APPLIED ECONOMETRICS  
**Level**: Graduate  
**Year**:  
**Semester**: I-II  
**ECTS Credits**: 7.5  
**Status**: Elective  
**Hours/Week**: 3  
**Total Hours**: 45  

### Course Coordinator:

**COURSE DESCRIPTION**

Students should have a good grasp of basic statistical/econometric concepts and basic mathematical tools, such as calculus and algebra. The first couple weeks will review basic concepts in math, probability, and statistics. While computer programming in SAS will be used in this course, no previous programming experience will be required.

**COURSE OBJECTIVES**

The primary objective of this course is to teach students applied econometric techniques in a highly empirical but theoretically rigorous context. This course is intended to be useful to MA/MS students who may not take any more econometrics as well prepare students for more advanced courses. Course presents an applied introduction to econometric techniques with some derivations of their properties, but leaves more theoretical treatment to future courses. For all groups, the course provides practical experience in the use of SAS. The course will make use of SAS (Statistical Analysis System) software, both in class and in required homework. SAS is a general-purpose statistical package in wide use across social science disciplines.

**COURSE CONTENTS**

- Review of Probability, Simple Linear Regression Model
- Multiple Regression: Estimation, Multiple Regression: Specification
- Multiple Regression: Inference, Multiple Regression: Binary Variables
- Multiple Regression: Model Fit Tues. Multiple Regression: OLS Asymptotics
- Heteroskedasticity, Specification and Data Issues
- Simultaneous equations, Time Series Analysis, Serial Correlation

### Teaching/Assessment

- **Description**
  - **Teaching Methods**
    - Lectures, discussion, research and presentation, homework
  - **Description (%)**
    - Midterm Exam 30%
    - Final Exam 35%
    - Homework 20%
    - Final Research Paper 15%

### Learning outcomes

Upon successful completion of this course, students will be able to:

- Understand basic estimation procedures, inference methods, asymptotic properties, and model formulation techniques in common linear regression models used in applied econometric analysis of cross-sectional and time-series data.
- Understand and address different estimation/specification problems typically faced in applied economic research using linear regression techniques (omitted variable bias, heteroskedasticity, multicollinearity, autocorrelation, etc.).
- Implement econometric techniques learned in class in an applied research context utilizing SAS software

### Language of Instruction

English

### Textbook(s)

1. *The Practice of Econometrics, classic and Contemporary*, Ernst R. Bernd, Addison
3. *Understanding Econometrics*, Denis Halcyossis, Thomson
**Course Code:** BUS 543  
**COURSE TITLE:** PROJECT MANAGEMENT

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<td>I-II</td>
<td>7.5</td>
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**Status:** Elective  
**Hours/Week:** 3  
**Total Hours:** 45

**Course Coordinator:**

**COURSE DESCRIPTION**
This course examines project management roles and environments, the project life cycle and various techniques of work planning, and control and evaluation to achieve project objectives. The tools currently available to project managers are discussed throughout this course.

**COURSE OBJECTIVES**
The course aims to give the student the basic theoretical and practical knowledge to design computer aided project management methodology and apply this methodology to the main areas of business such as production, finance and marketing.

**COURSE CONTENTS**
- Introduction to Project Management
- Project Organization, Leadership and Project Teams
- Working with Project Tasks
- Outlining a Project
- Establishing Task Dependencies
- Managing Project Resources
- Scheduling with Resources
- Tracking Project Progress
- Project Reports, Forms, and Plans
- Managing Project Risk
- Project Management Software

**TEACHING/ASSESSMENT**

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<tr>
<td><strong>Teaching Methods</strong></td>
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<tr>
<td>Instruction, discussion, project, presentation</td>
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<tbody>
<tr>
<td><strong>Student Assessment Methods</strong></td>
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<tr>
<td>Midterm exam 25%</td>
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<tr>
<td>Project 25%</td>
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<td>Final exam 50%</td>
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<tbody>
<tr>
<td>A student who successfully finishes the course is expected to have acquired the competency to develop project management plans and to apply them to the business environment using computer aided tools.</td>
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**Language of Instruction:** English

**Textbook(s)**
### Course Code: BUS 547
### COURSE TITLE: MATHEMATICAL PROGRAMMING

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<tr>
<td>Elective</td>
<td>3</td>
<td>45</td>
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### Course Coordinator:

This course will be an introduction to mathematical programming, with an emphasis on techniques for the solution and analysis of deterministic linear models. The primary types of models to be addressed will be linear programming, network flow, and integer linear programming. However, the course will touch on more complex models, such as those incorporating nonlinear constraints or uncertainty. The main emphasis will be on solution techniques and on analysis of the underlying mathematical structure of these models. As a supporting theme, the course will also emphasize effective modeling techniques, the use of modeling languages, such as AMPL, and the use of commercial solvers.

### COURSE OBJECTIVES

The goals of this course are for students to:

- Improve their ability to rigorously prove mathematical statements.
- Cultivate an ability to analyze the structure of and mathematically model various complex systems occurring in industrial applications.
- Develop knowledge of the mathematical structure of the most commonly used deterministic linear optimization models.
- Develop an understanding of the techniques used to solve linear optimization models using their mathematical structure.
- Develop an understanding of the use of modeling languages for expressing and solving optimization models.
- Develop knowledge of existing solvers for linear optimization.

### COURSE CONTENTS

- Review of Modeling
- The Geometry of Linear Models, The Simplex Method
- Modeling Languages, Duality Theory, Sensitivity Analysis
- Transportation problems, Assignment models
- Network Flow Models, Integer Programming Models
- Advanced Models and Methods

### TEACHING/ASSESSMENT

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<td>Lecture, Discussion, Group work/Project</td>
<td>Midterm exam 25% Participation and group work 25% Final exam 50%</td>
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<td>Analyze the structure of and mathematically model various complex systems</td>
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<tr>
<td>Understand the techniques used to solve linear optimization models</td>
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<tr>
<td>Understand and use the modeling languages for expressing and solving optimization models</td>
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### Language of Instruction

English

### Textbooks

1. Frank R. Giordiano, A First Course in Mathematical Modeling