Modulhandbuch

Master Mechatronic Systems

(M. Eng.)

Hochschule
Augsburg University of
Applied Sciences

VORBEMERKUNG ZU CREDITS

Die Hochschule Augsburg verwendet das European Credit Transfer System (ECTS) zur Bewertung des Umfangs von Lehrveranstaltungen, während die Partnerhochschule University of Ulster hierfür das nationale System des Vereinigten Königreichs (UK) verwendet. Nach ECTS beträgt der Umfang eines Studiensemesters 30 ECTS Credit Points (ECTS-CP) während er im UK-System 60 UK Credit Points (UK-CP) beträgt. Da das ECTS nur ganzzahlige CP-Werte zulässt, ist bei einem Semester mit vier Modulen gleichen Umfangs in einem Semester keine exakte Umrechnung aus dem UK-System in das ECTS mit dem Faktor 1/2 möglich. Daher werden die Module der Hochschule Augsburg in diesem Modulhandbuch mit 8 ECTS-CP und 15 UK-CP bewertet. Die Module der University of Ulster, die dort intern ebenfalls alle mit 15 UK-CP bewertet werden, werden beim Credit Transfer an die Hochschule Augsburg alle mit 7 ECTS-CP bewertet, woraus sich über zwei aufeinanderfolgende Semester 60 insgesamt ECTS-CP ergeben.

VORBEMEKRUNG FÜR M-APR STUDIERENDE

Die Module, die in Augsburg in diesem Master, angeboten werden, bestehen aus einem Vorlesungsanteil (5 ECTS) und einem Projektanteil (3 ECTS). MAPR-Studierende belegen jeweils nur den Vorlesungsanteil mit 5 ECTS je Modul.

REMARK ON CREDITS

The University of Applied Sciences Augsburg uses the European Credit Transfer System (ECTS) for rating the size of modules, whereas the University of Ulster uses the national rating system of the United Kingdom (UK). According to ECTS one semester comprises 30 ECTS credit points (ECTS-CP), whereas in the UK system it comprises 60 UK credit points (UK-CP). As ECTS only allows integer CP values, in case of a semester comprising four modules of equal size an exact conversion from the UK system into ECTS by a factor of 1/2 is not possible. Therefore, the modules of the University of Applied Sciences Ausgburg are rated in this module handbook to have 8 ECTS CP and 15 UK-CP. The modules of the University of Ulster, which are also rated internally to have 15 UK-CP each, are rated to have 7 ECTS-CP each in the credit transfer to the University of Applied Sciences Augsburg, whereby two successive semesters have a total of 60 ECTS-CP.

MODULE TITLE:	**ELECTRIC POWER SYSTEMS**
MODULE CODE:	**EEE533**
YEAR of INTRODUCTION / REVISION	2015
MODULE LEVEL:	6
CREDIT POINTS:	8 ECTS / 15 UK
SEMESTER:	2
LOCATION:	Jordanstown (taught in Germany)
PREREQUISITE(S):	Detailed knowledge in basic structure of electric power supply systems and network components such as substations, cable, overhead lines and circuit breakers
CO-REQUISITE(S):	None
MODULE CO-ORDINATOR(S):	Owens, F J Dr., Jordanstown School of Electrical and Mechanical Engineering
TEACHING STAFF RESPONSIBLE FOR MODULE DELIVERY:	Prof Dr. M. Finkel MBA, Prof Dr. Ch. Schwaegerl Augsburg University of Applied Sciences
HOURS:	Lecture: 46 Tutorial: 24 Assignment: 40 Independent Learning: 40
TOTAL EFFORT HOURS:	150
ACADEMIC SUBJECT:	Electrical Engineering

RATIONALE

The development of sustainable concepts for reliable, affordable and environmentally friendly energy supply is one of the most urgent, global challenges confronting mankind in the 21st century.

Power generation plays a dominant role both in industrialised and developing countries. Today, power generation is mainly based on thermal and hydro power plants, with increasing shares of renewable and distributed generation technologies based on combined heat and power plants.

The drive for lower-carbon generation technologies, combined with improved efficiency on the demand side and technical developments of information and communication technologies, will enable customers to become much more inter-active with electricity networks. These fundamental changes will significantly impact design and control of transmission and distribution networks (Smart Grids).

This transition to electricity grids of the future requires professionals who are proficient in power engineering.

AIMS

This module aims to provide students with an understanding of the operation of modern electrical power systems with increasing shares of renewable and low carbon generation, along with the techniques to undertake a basic technical analysis of key electrical devices and systems.

LEARNING OUTCOMES

A successful student will be able to show that he/she can:

KNOWLEDGE AND UNDERSTANDING

K1 Understand the basis of operation of modern electrical power systems.

K2 Be able to calculate effects in electrical power systems.

K3 Perceive the principles of innovative solutions in electricity supply.

K4 Know the components required for sustainable electricity supply systems.

INTELLECTUAL QUALITIES

I1 Analyse energy transmission and distribution problems and identify appropriate solution methods.

I2 Devise solutions for energy supply problems using state-of-the-art technologies.

I3 Evaluate electricity networks

I4 Adapt basic planning approaches to electricity systems.

PROFESSIONAL/PRACTICAL SKILLS

P1 Demonstrate informed decision making skills whilst considering a range of impacts in supply systems.

P2 Identify problems, produce and appraise solutions to network operational problems.

P3 Use simulation software to configure power systems.

TRANSFERABLE SKILLS

T1 Appreciate the value of formal description methods as the basis for problem solving.

T2 Know the benefits and limitations of simulation as an engineering tool.

T3 Perform effectively within a group in a practical project.

CONTENT

Network components
- Transformers
- Operational behaviour of Power Lines
- Reactive Power Compensation in High Voltage Grids
- High Voltage DC transmission

Transmission and distribution system planning
- Load-flow, methods of network calculation
- Network protection

Network operation
- Monitoring and control
- Reliability and stability

Energy Storage Systems

Power system economics
- Current regulatory framework
- Energy markets
- Electricity tariffs

Smart Grids
- Impact of renewable generation on networks
- Smart generation
- Smart consumption
- Smart distribution grids
- Examples

- Presentation of selected technologies by demonstrations and excursions.

LEARNING AND TEACHING METHODS

The syllabus material shall be covered through formal lectures and a large element of hands-on practical work using software packages for simulation and optimisation.

ASSESSMENT

By formal examination, coursework with assignments.

<u>Coursework</u>: 30%

Mini project in Smart Grids/Network Simulation: Design, presentation and report.

Examination: 70%

The examination paper will be of 2 hours duration and consist of 6 questions worth 20 marks each; the student will be required to answer 5 of these.

30% Coursework 70% Examination

READING LIST

ABB, Switchgear Manual, 11th edition, ABB, 2006.

P. Kundur, Power System Stability and Control, McGraw-Hill, 1994, ISBN 0-07-035958-X.

K. Bhattacharya, M. H. J. Bollen and J. E. Daalder, Operation of restructured power systems, Kluwer Academic Publishers, USA, 2001.

Hensing, I.; Pfaffenberger, W.; Ströbele, W.: “Energiewirtschaft“, Vahlen Verlag (ISBN 3-486-24315-2)

Bernd M. Buchholz, Zbigniew Styczynski, Smart Grids – Fundamentals and Technologies in Electricity Networks, Springer 2014

C. Rehtanz, Monitoring, Control and Protection of Interconnected Power Systems, Springer 2014

CIGRE, technical brochure 475: Demand side integration, 2011

In addition to many selected published papers in IEEE.

SUMMARY DESCRIPTION

The module covers theoretical and practical aspects of electric power systems with a large share of decentralised and renewable generation units.

MODULE TITLE:	**POWER ELECTRONICS AND ELECTRICAL DRIVES**
MODULE CODE:	**EEE534**
YEAR OF INTRODUCTION/ REVISION:	2015
MODULE LEVEL:	4 / 6
CREDIT POINTS:	8
MODULE STATUS:	Optional
SEMESTER:	2
LOCATION:	Jordanstown (taught in Augsburg, Germany)
E-LEARNING:	Web Supplemented
PREREQUISITE(S):	Part Power Electronics: Knowledge of the behaviour of buck and boost converters, half-bridges and single-phase inverters. Part Electrical Drives: Basic knowledge of function and operating behavior of electrical machines (DC and rotating field machines)
CO-REQUISITE(S):	None
MODULE CO-ORDINATOR(S):	Rea, Chris, Jordanstown School of Engineering
TEACHING STAFF RESPONSIBLE FOR MODULE DELIVERY:	Professor Dr. Manfred Reddig Professor Dr. Wolfgang Meyer University of Applied Sciences Augsburg
HOURS:	Lecture: 46 Tutorial : 24 Laboratory/Design Assignment : 40 Independent Learning : 40
TOTAL EFFORT HOURS:	150
ACADEMIC SUBJECT:	Electrical / Electronic

RATIONALE

Very high efficiency and an increase of power density including very low EMI-disturbances are essential for the design and development of Power Electronic systems. To archive these requirements, modern power semiconductors components has to be used. Complex control and simulation algorithms must be investigated. Also, a high sophisticated thermal management is necessary.

Comprehensive knowledge in electromechanical energy conversion as a challenging technical area of the modern life is for electrical engineering students of crucial importance

AIMS

Part: Power Electronics

To gain mathematical and engineering skills in the analysis, simulation and control of complex Power Electronic and Electrical Drive systems.

To provide the students with knowledge of the physical and electrical behaviour of modern power semiconductor components.

The knowledge of basis of EMI and thermal management gives hints to the design of electronic systems.

The module will enable students to apply tools of advanced simulation and control techniques. Working on examples in selected engineering areas leads to a comprehensive knowledge.

Part: Electrical Drives

The students will gain engineering skills in modelling, analysis, design and control of electrical drive systems including their components.

Advanced simulation tools and the work on several case studies will be involved in order to offer a deep understanding.

LEARNING OUTCOMES

A successful student will be able to:

KNOWLEDGE AND UNDERSTANDING

K1 Perceive the behaviour of complex electro-mechanical systems.

K2 Have a thorough acquaintance with modern techniques for Power Electronics and Electrical Drives.

K3 Employ effectively modern design methodologies and tools for the design of Power Electronics and Electrical Drives.

K4 Be familiar with various technologies their advantages and disadvantages

K5 Demonstrates the ability to identify and respond to interrelationships between Power Electronics and Electrical Drives.

INTELLECTUAL QUALITIES

I1 Design the power train to meet a particular specification.

I2 Analyse complex mechatronic systems; detect problems and find solutions.

I3 Judge, based on the knowledge and rules of design details, the influence of different Electrical Drive types and Power Electronics topologies on the application.

PROFESSIONAL/PRACTICAL SKILLS

P1 Use simulation tools for control, optimisation and prototyping.

P2 Design and test of Power Electronics circuits and Electrical actuators as well as the complete power train..

TRANSFERABLE SKILLS

T1 Communicate effectively using oral and written communication.

T2 Perform effectively within a group in the conduct of a practical control design project.

CONTENT

Part: Power Electronics

Review:

Overview of the contents and Introduction in modern power semiconductor, space vector theory, three-phase- inverter

Modern power Semiconductor:

Physical behaviour of:

- vertical structure MOSFET with and without trench – technology,
- NPT, PT and filed stopp – IGBTs
- Influence of Si-, Si-Carbide and GaN- devices

Space vector:

- Basic theory of the space vector
- Calculation of harmonics and power in switch three phase systems
- Space vector modulation techniques

Three-phase inverter:

- Basic topology of a three- phase inverter,

- Control algorithms and simulations using the space vector
- High efficient control techniques
- EMI- analysis, simulations and development of design rules

Part: Electrical Drives

Electric Machines – Analysis and Design

- Modelling and analysis with concentrated parameters
- Finite element modelling and analysis
- Electric machines design and optimization

Advanced Electric Drives

- Advanced modelling for transients
- Advanced control strategies
- Simulation techniques

LEARNING AND TEACHING METHODS

The syllabus material shall be covered through formal lectures and a large element of hands-on practical work using software packages for simulation and optimisation.

ASSESSMENT

By formal examination, coursework with group design projects and assignments,

Coursework :

A group based mini-project involving control design, simulation and testing of a laboratory control set-up. 25%

Examination:

The examination paper will be of 2 hours and consist of two sections A & B with a total of 6 questions of equal weight with no elements of choice. Section A will govern Power Electronics part and will consist of 3 questions. Section B will govern Electrical Drives and will consist of 3 questions.

75%

25% Coursework 75% Examination

READING LIST

Part: Power Electronics

Power Electronics Handbook	M. H. Rashid	Academic Press	2010

Fundamentals of Power Electronics	R. W. Erickson D. Maksimovic	Springer	2001
Power Electronics	D. W. Hart	Mcgraw Hill Book Co	2010
Semiconductor Power Devices	J. Lutz H. Schlangenotto U. Scheuermann	Springer	2011
PCB Design for Real-world EMI-Control	B. R. Archambeault	Springer	2002
EMI Troubleshooting Techniques	M. Mardiguian	Irwin/ Mcgraw Hill	1999
Conducted EMI identification in power electronic converters	P. Musznicki	VDM- Verlag	2009
Vector Control of Three-Phase AC Machines	N. P. Quang J. A. Dittrich	Springer	2010
Control in Power Electronics	M. P. Kazmierkowski J. D. Irwin	Academic Press	2002
Part: Electrical Drives			
Electric Machines	I. Boldea, L. Tutelea	CRC Press	2009
Electrical Machine Analysis using Finite Elements	N. Bianchi	CRC Press	2005
Electric Drives	I. Boldea, S.A. Nasar	CRC Press	2006
Electric Motor Drives	R. Krishnan	Prentice Hall	2001
Electrical Machinery Fundamentals	F. Allythi	LAP Lambert Academic Publishing	2012

SUMMARY DESCRIPTION

The module is offered in Augsburg, Germany, and covers the theoretical and practical aspects of Power Electronics and Electrical Machines combined with the required new power semiconductors.

MODULE TITLE:	**VLSI DESIGN**
MODULE CODE:	**EEE535**
YEAR OF INTRODUCTION / REVISION	
MODULE LEVEL:	6
CREDIT POI NTS:	8 ECTS /15 UK
SEMESTER:	2
LOCATION:	Jordanstown (taught in Germany)
E LEARNING	WEB Supplemented
PREREQUISITE(S):	Pass in EEE51 5J 1, or equivalent.
CO-REQUISITE(S):	None
MODULE CO-ORDINATOR(S):	Owens, F J Dr., Jordanstown School of Electrical and Mechanical Engineering
TEACHING STAFF RESPONSIBLE FOR MODULE DELIVERY:	Prof. Dr.-Ing. Friedrich Beckmann Prof. Dr -Ing. Matthias Kamuf Johann Faerber MPhil University of Applied Sciences, Augsburg, Germany
HOURS:	Lecture: 40 Tutorial: 20 Laboratory/Design Assignment: 40 Independent Learning: 50
TOTAL EFFORT HOURS:	150
ACADEMIC SUBJECT:	Electronic Engineering

RATIONALE

The trend in electronics is to achieve greater packing density for more and more sophisticated signal processing functions. Hence Very Large Scale Integration (VLSI) is fundamental to modern electronic system design and implementation.

AIMS

To provide students with the knowledge of software design techniques for integrated circuits and implementation into various choices of realisation to meet given signal processing requirements. To instill awareness of the limitations of the technology, and to produce efficient and tested circuits on silicon. To handle complex hierarchically structured systems and percept the inherent problems of verifying correct function.

As an appreciated side effect the students' ability to abstract complex functions should be fostered and their skills in reading and comprehending technical specifications as well as extracting the concise content improved.

LEARNING OUTCOMES

A successful student will be able to show that he/she can:

KNOWLEDGE AND UNDERSTANDING

K1 Become familiar with the design styles and the rules for current implementation approaches.

K2 Write behavioural and structural code in a hardware description language according to a specification in natural language.

K3 Handle complex hierarchical structures

K4 Be aware of the limitations of functional verification and specify verification patterns.

K5 Have a thorough acquaintance with the r oles of automatic testing and design for testability.

INTELLECTUAL QUALITIES

I1 Read and comprehend technical specifications.

I2 Design, code, simulate, synthesise and implement complex digital functions and systems.

I3 Critically evaluate verification approaches, be aware of the limitations and risks, especially in life supporting systems.

PROFESSIONAL/PRACTICAL SKILLS

P1 Use the available range of CAD tools for HDL input, simulation, verification, synthesis, static timing analysis and layout.

TRANSFERABLE SKILLS

T1 Recognise the inherent ambiguity of natural language in contrast to formal language

T2 Handle complex systems beyond the comprehension of one single human being through abstraction, communication and teamwork

T3 Appreciate the difference between functional verification, formal verification and falsification as well as the limitations in proving the correctness of theories and finding truth through simulation or testing.

CONTENT

Design Styles:

Full custom design; standard cell approach; hardware and behaviour description entry approach; functional abstraction; rules and hints on decision-making.

Design Flow:

Function entry; verification; timing analysis; synthesis layout;

Hierarchical Design Styles:

Cells; blocks; buses; high-level hardware description language (HDL).

Hardware Description Language Entry:

Behavioural, structural and functional function entry using VHDL.

CAD Tools: Compilation; simulation; synthesis; static timing analysis; routing. placement.;

Guide to verifying complex systems.

Introduction to Testing:

Manual and automatic test pattern generation. Design for Testability: rules; procedures; methods.

Management Issues:

Splitting designs into blocks; releases and release management; bug tracking; design rules.

TEACHING AND LEARNING METHODS

The syllabus material shall be covered through formal lectures and a large element of hands-on practical work using software packages for design, simulation and testing.

ASSESSMENT

By formal examination, coursework with group design projects and assignments.

Coursework 1 :

5 hands-on CAD lab experiments

pass/requirement for coursework 2

Coursework 2:

Mini project: design, presentation and report

50%

Examination:

The examination paper will be of 3 hours duration and consist of 8 questions worth 12.5 marks each; with no element of choice. 50 %

50% Coursework 50% Examination

READING LIST / Required Reading

VHDL Short Course & Guide to Synthezisable Code	A. Eder	FHA Intranet	2005
The Essence of Digital Design	Barry Wilkinson	Prentice Hall Europe	1998
The Designer' s Guide to VHDL	Ashenden	Morgan Kaufman	2001
Hardware Design Verification: Simulation and Formal Method Based Approaches	William K. Lam	Prentice Hall	2005

Recommended Reading:

Digital System Design and VHDL	Mark Zwolinski	Prentice Hall	2000
Microelectronic Systems: Design, Modeling and Testing	Buchanan	Arnold	1997
CMOS Circuit Design Layout and Simulation	Baker et al.	IEEE Press	1998
HDL Chip Design	Smith	Doone	1997
Principles of Modern Digital Design	Parag K. Lala	Wiley	2007
VHDL Made Easy	Pellerin & Taylor	Prentice-Hall	1997
VHDL for Programmable	Skahill	Addison-Wesley	1996

SUMMARY DESCRIPTION

The module is offered in Germany and covers the theoretical and practical aspects of VLSI by design and fabrication of ASIC chips specified to perform signal processing functions.

MODULE TITLE:	**CONTROL & AUTOMATION**
MODULE CODE:	**EEE536**
YEAR OF INTRODUCTION / REVISION	2014
MODULE LEVEL:	6
CREDIT POINTS:	8 ECTS /15 UK
SEMESTER:	2
LOCATION:	Jordanstown (taught in Germany)
E LEARNING	Web Supplemented
PREREQUISITE(S):	Pass in module EEE347, or equivalent.
CO-REQUISITE(S):	None
MODULE CO-ORDINATOR(S):	Owens, F J Dr., Jordanstown School of Engineering
TEACHING STAFF RESPONSIBLE FOR MODULE DELIVERY:	Prof Dr R Grossmann Prof Dr P Kopystynski Prof Dr W Zeller, University of Applied Sciences Augsburg, Germany
HOURS:	Lecture : 37 Tutorial : 18 Assignment : 45 Independent Learning : 50
TOTAL EFFORT HOURS:	150
ACADEMIC SUBJECT:	Electronic Engineering

RATIONALE

Control and automation are of key importance for increasing industrial productivity, particularly in an environment of high labour cost. Hence there is a high demand for electrical engineers with a qualification in this field.

AIMS

To familiarise the student with fundamental aspects of automated systems and with common methods and tools for solving automation problems. Further to enable the student to cooperate effectively with professionals in related fields, such as industrial engineering.

LEARNING OUTCOMES

A successful student will be able to show that he/she can:

KNOWLEDGE AND UNDERSTANDING

- K1 Become familiar with discrete event systems as the basis for modelling automation problems.
- K2 Be able to treat random effects in automation problems.
- K3 Perceive the principles of PLC networks.
- K4 Understand the principles and limitations of sensors and sensor systems.

INTELLECTUAL QUALITIES

- I1 Analyse automation problems and identify appropriate solution methods.
- I2 Devise solutions for automation problems using state-of-the-art tools.
- I3 Extract physical properties of real sensors and build analog simulation models from them.

PROFESSIONAL/PRACTICAL SKILLS

- P1 Use simulation software to analyse the behaviour of a discrete event system.
- P2 Use PLC programming tools based on a graphical description of a discrete event system.
- P3 Configure a network of Programmable Logic Controllers connected via fieldbus and /or Ethernet.
- P4 Develop controller software according to the rules of IEC 61131-3.
- P5 Simulate sensors and circuits (e.g. with PSPICE or LabView)
- P6 Analyze data sheets & select appropriate components for automation & control systems

TRANSFERABLE SKILLS

- T1 Appreciate the value of formal description methods as the basis for problem solving.
- T2 Know the benefits and limitations of simulation as an engineering tool.
- T3 Perform effectively within a group in the conduct of a practical project.

CONTENT

Petri Net basics, timed models, application in programming tools for programmable controllers.

Introduction to stochastic systems, discrete- and continuous-time Markov chains.

Review of the programming concept for PLCs according to the norm IEC 61131-3.

Connectivity between SoftPLCs, Input/Output devices and commercial applications, e.g. visualisation based on OPC or industrial ethernet.

Design and verification of safety related programmable control systems according to European standards.

Modelling of nonlinear characteristics of temperature, magnetic, optic and chemical sensors.

Modelling of dynamic effects and limitations of sensors, e.g. cut-off frequency and parasitic elements

LEARNING AND TEACHING METHODS

The syllabus material shall be covered through formal lectures as well as practical work using software tools for programming and simulation.

ASSESSMENT

By formal examination, coursework with assignments.

Coursework:

Mini project in PLC-programming: Design, presentation and report.

30%

Examination:

The examination paper will be of 2 hours duration and consist of 6 questions worth 20 marks each; the student will be required to answer 5 of these.

70%

30% Coursework 70% Examination

READING LIST

Introduction to Discrete Event Systems	Cassandras, Lafortune	Kluwer Academic Press 0-7923-8609-4	1999
Discrete, Continuous and Hybrid Petri Nets	David, Alla	Springer 3-540-22480-7	2005
Discrete-Event System Theory	Tornambe	World Scientific 9810223617	1995
IEC 61131-3: Programming Industrial		John, Tiegelkamp 2010	Springer

Automation Systems		978-3642120145	
OPC : From Data Access to Implementation and Application"	Iwanitz, Lange, Burke	Hüthig 978-3800732425	2010
Functional safety of machine controls – Application of EN ISO 13849	Hauke, et al.	DGUV 978-88383-793-2	2009
Analogue Design and Simulation Using Orcad Capture and Pspice.	Fitzpatrick	Newnes 978-0080970950	2011
LabVIEW 2009 Student Edition	Bishop	Prentice Hall 978-0132141291	2009

SUMMARY DESCRIPTION The module is offered in Germany and covers theoretical and practical aspects of modern process automation concepts.

MODULE TITLE:	**COMMUNICATIONS**
MODULE CODE:	**EEE538**
YEAR OF INTRODUCTION/REVISION	2014
MODULE LEVEL:	6
CREDIT POINTS:	8 ECTS /15 UK
SEMESTER:	2
MODULE STATUS	Optional
LOCATION:	Jordanstown (taught in Augsburg, Germany)
E LEARNING	Web Supplemented
PREREQUISITE(S):	none
CO-REQUISITE(S):	none
MODULE CO-ORDINATOR(S):	Owens, F J Dr., Jordanstown School of Engineering
TEACHING STAFF RESPONSIBLE FOR MODULE DELIVERY:	Prof. Dr. F. Beckmann Prof. Dr. M. Kamuf Prof. Dr. R. Stolle University of Applied Sciences Augsburg, Germany
HOURS:	Lecture: 40 Tutorial: 20 Laboratory/Design Assignment: 40 Independent Learning: 50
TOTAL EFFORT HOURS:	150
ACADEMIC SUBJECT:	Electronic Engineering

RATIONALE

The trend in communications is to replace more and more analogue functions by digital ones. Hence, signal processing algorithms and their implementations are fundamental to modern digital communication systems.

AIMS

To provide the students with mathematical, engineering skills and the knowledge of signal processing algorithms and architectures for digital communication systems. To install awareness of the limitations of different choices of implementation. To enable students to integrate analogue and digital building blocks of a digital communication system into an entire system.

LEARNING OUTCOMES

A successful student will be able to show that he/she can:

KNOWLEDGE AND UNDERSTANDING

K1 Understand the functionality and the limitation of modern algorithms and protocols for communication systems

K2 Have a thorough aquaintance with writing and testing algorithms and protocols and also how to integrate them in an existing signal processing architecture

K3 Develop simulation models of communication systems and their signal processing algorithms for simulation in frequency domain, time domain, floating point and fixed-point.

K4 Develop implementations of signal processing algorithms on a programmable hardware-platform.

K5 Be aware of hardware limitations imposed on signal processing algorithms and find implementation choices which take these into account.

INTELLECTUAL QUALITIES

I1 Read and comprehend technical specifications and block diagrams of communication systems.

I2 Model, design, simulate, optimize, test and implement communication systems and their signal processing algorithms.

I3 Critically evaluate choices of implementation of communication systems and their algorithms with regard to design effort, hardware effort, power consumption, and overall system cost.

PROFESSIONAL/PRACTICAL SKILLS

P1 Use the available range of high-level languages for algorithm modeling, simulation and implementation of communication systems and their building blocks.

TRANSFERABLE SKILLS

T1 Improve oral and written communication skills.

T2 Work effectively in a team.

T3 Be able to think and work on different levels of abstraction.

CONTENT

Codes

simulation of a communication channel, rudiments of number theory and algebra, programming field arithmetic, theory of channel codes and codes of information security, application of the codes to communication systems; source coding;

Protocols

Protocol Layers, Media Access Control, Packet Formats, Adressing, Ethernet, Wireless Networks, Collision Detection and Avoidance, Packet Acknowledge and Retransmission, Routing, Switching, Flow Control, IP, TCP, UDP, RTP, ICMP, DNS, Quality of Service, Network Security

Signal processing algorithms

e. g. modulation and demodulation; automatic gain control; receiver synchronisation; adaptive and non-adaptive digital filters, recursive digital filters, resampling filters

Implementations

DSP implementations; FPGA implementations; transceiver architectures; oversampling; quantization

LEARNING AND TEACHING METHODS

The syllabus material shall be covered through formal lectures and a large element of hands-on practical work for design, simulation and testing.

ASSESSMENT

By formal examination, coursework with group design projects and assignments.

Coursework 1:

coursework exercises

pass/requirement for coursework 2

Coursework 2:

Mini project: design, presentation and report

50%

Examination:

The examination paper will be of 2 hours duration and consist of 8 questions worth 12.5 marks each; with no element of choice.

50%

READING LIST

Channel Codes: Classical and Modern	Lin, S. Costello, D.	Cambridge University Press	2009
Error Correction Coding - Mathematical Methods and Algorithms	Moon, T.K.	Wiley	2005
Error Control Coding	Friedrichs, B.	Springer	to appear
Computer Networks	A. Tanenbaum	Prentice Hall	2010
Digital Signal Processing with Field Programmable Gate Arrays	Uwe Meyer-Bäse	Springer	2007
Handbook of Applied Cryptography	Menezes et al.	CRC Press	2001
Communication Systems Engineering	Proakis, J.G., Salehi, M.	Prentice Hall	2001
Fundamentals of Wireless Communication	Tse, D., Viswanath, P.	Cambridge	2005
Adaptive Filter Theory	Haykin, S.	Prentice Hall	2001

SUMMARY DESCRIPTION

The module is offered in Germany and covers theoretical and practical aspects of digital communication systems.

MODULE TITLE:	**MECHATRONICS**
MODULE CODE:	EEE545
YEAR OF INTRODUCTION / REVISION	2014
MODULE LEVEL:	6
CREDIT POINTS:	8 ECTS /15 UK
SEMESTER:	2
LOCATION:	Jordanstown (taught in Germany)
E LEARNING	WEB Supplemented
PREREQUISITE(S):	Pass in EEE347, or equivalent
CO-REQUISITE(S):	None
MODULE CO-ORDINATOR(S):	Owens, F J Dr., Jordanstown School of Engineering
TEACHING STAFF RESPONSIBLE FOR MODULE DELIVERY:	Professor Dr. F. Raps Professor Dr. F. Kerber Professor Dr. C. Markgraf Hochschule Augsburg
HOURS:	Lecture : 40 Tutorial : 20 Laboratory/Design Assignment: 40 Independent Learning : 50
TOTAL EFFORT HOURS:	150
ACADEMIC SUBJECT:	Electrical / Electronic / Mechanical Engineering

RATIONALE

Simulation and feedback control techniques are essential for the design and development of mechatronic products. Sophisticated software tools make it easy to design and test control algorithms for complex systems. Methods like Rapid Control Prototyping costs and time in the development.

Bonding is a key manufacturing technology in mechatronics as it allows combining electronic circuits directly with sophisticated micro-mechanical systems.

Thermal Management is necessary to increase the reliability of electronic systems

AIMS

To gain mathematical and engineering skills in the analysis, simulation and control of complex dynamic mechatronic systems.

The module will enable students to apply tools of advanced simulation and feedback control techniques. Working on examples in selected engineering areas leads to a comprehensive knowledge.

Bonding technology will give students a deep understanding how mechatronic systems can be built from electronics and micro-mechanical parts.

The knowledge of basis of thermal management gives hints to the design of electronic systems.

LEARNING OUTCOMES

A successful student will be able to show that he/she can:

KNOWLEDGE AND UNDERSTANDING

K1 Perceive the behaviour of complex electro-mechanical systems.

K2 Have a thorough acquaintance with modern feedback control strategies and techniques.

K3 Employ effectively modern control design methodologies and tools for the design and implementation of feedback controllers.

K4 Be familiar with various bonding technologies such as flip-chip and wire bonding, their advantages and disadvantages in micro-systems.

K5 Appreciate the necessity of cooling techniques.

INTELLECTUAL QUALITIES

I1 Design control systems to meet a particular specification.

I2 Analyse complex mechatronic systems; detect problems and find solutions.

I3 Judge, based on the knowledge and rules of design as well as manufacturing details, the influence of material problems on the reliability of electronic and mechatronic systems.

PROFESSIONAL/PRACTICAL SKILLS

P1 Use CAD tools for control, simulation, optimisation and prototyping.

P2 Design and test feedback control systems.

TRANSFERABLE SKILLS

T1 Communicate effectively using oral and written communication.

T2 Perform effectively within a group in the conduct of a practical control design project.

T3 A thorough understanding of control theory is an asset in many aspects of modern life such as economy, politics and especially the role of hormones and enzymes in biology.

CONTENT

Review:

Overview, Introduction to MATLAB and SIMULINK.

Modelling and Simulation of Dynamic Systems: Differential equations, state space models, transfer functions.

Closed Loop Control: Definitions; state space concepts; analogue and digital control systems.

Design of Control Systems with MATLAB: Exercises with selected Problems (Tutorial and exercises).

SIMULINK – a Graphical Simulation Environment: Real time systems; Rapid Control Prototyping

Bonding:

Various bonding technologies such as flip-chip and wire bonding; advantages and disadvantages.

Design and manufacturing issues.

Influence of material problems especially of lead-free solder materials and progressing miniaturisation on the reliability of electronic and mechatronic systems.

Basics of thermal management and future techniques.

TEACHING AND LEARNING METHODS

The syllabus material shall be covered through formal lectures and a large element of hands-on practical work using software packages for simulation and optimisation.

ASSESSMENT

By formal examination, coursework with group design projects and assignments,

Coursework 1:

An individual computer based assignment involving simulation and control exercises.

20%

Coursework 2:

A group based mini-project involving control design, simulation, and testing of a laboratory control set-up.

30%

Examination:

The examination paper will be of 2 hours and consist of two sections A & B with a total of 10 questions of equal weight with no elements of choice.

Section A will govern the control and simulation part and will consist of 6 questions.

Section B will govern the bonding technologies, the materials and the thermal management and will consists of 4 questions.

50%

50% Coursework 50% Examination

READING LIST

Automatic Control Systems	Kuo, B. C.&Golnaragi, F	Wiley	2009
Automatic Control Systems	Wolovich, W. A.	Oxford University Press	1993
Modern Control Systems Wesley	Dorf, R. C.; Bishop, R. H. 2010		Addison-
Control System Design An Introduction to State-Space Methods	Friedland, B	McGraw-Hill	2005
Control Software for Mechanical Systems: Object-Oriented Design in a Real-Time World	Auslander, D M Ridgely, J R & Ringgenberg, J D	Prentice Hall	2002
Control Tutorials for MATLAB and Simulink: A Web-Based Approach	Messner, W C & D. M. Tilbury	Addison-Wesley	1998
Modern Control Design: with MATLAB and Simulink	Tewari, A	John Wiley & Sons	2002
Electronic Packaging: Design, Materials, Process, and Reliability	Lau, John H & al.	McGraw-Hill Professional	1998
Chip Scale Package: Design, Materials, Process, Reliability, and Applications	Lau, John H & al.	McGraw-Hill Professional	1999
Solder Joint Reliability of BGA, CSP, Flip Chip, and Fine Pitch SMT Assemblies	Lau, John H, Yi-Hsin Pao	McGraw-Hill Professional	1996

SUMMARY DESCRIPTION

The module is offered in Germany and covers the theoretical and practical aspects of control and simulation techniques for mechatronic systems combined with electronics and bonding technologies to connect both.

MODULE TITLE:	**MEMS MATERIALS AND SYSTEM SIMULATIONS**
MODULE CODE:	**MEC516**
MODULE LEVEL:	6
CREDIT POINTS:	8 ECTS / 15 UK
SEMESTER:	2
LOCATION:	Jordanstown (taught in Germany)
PREREQUISITE(S):	None
CO-REQUISITE(S):	None
MODULE CO-ORDINATOR(S):	Rea, Chris Mr., Jordanstown School of Electrical and Mechanical Engineering
TEACHING STAFF RESPONSIBLE FOR MODULE DELIVERY:	Prof Dr. B. Eckert Prof Dr. A. Frey Hochschule Augsburg
HOURS:	Lecture : 40 Tutorial : 20 Assignment : 40 Independent Learning: 50
TOTAL EFFORT HOURS:	150
ACADEMIC SUBJECT:	Mechanical Engineering / Mechatronic Engineering

RATIONALE

The miniaturization of components is a key issue in several industrial fields like electronics, medical technology, mechatronics and general engineering. Simulation is a basic tool for the design of micro-electro-mechanical systems (MEMS). Because material behaviour varies with structure dimension theoretical und practical understanding of this dependence is essential for realistic modelling.

AIMS

In this course the students learn basic modelling techniques with finite element software. Emphasis is taken on multiphysics simulation, e.g. electro-mechanical, thermo-mechanical or electro-thermo-mechanical.

Furthermore, the students learn several advanced measuring techniques to determine the mechanical properties like Youngs Modulus, yield stress and work hardening behavior of small structures.

LEARNING OUTCOMES

A successful student will be able to show that he/she can:

KNOWLEDGE AND UNDERSTANDING

K1 Understanding the physics of the deformation of small structures

K2 Knowing different measurement techniques to determine the mechanical properties of small volumes

K3 Having an idea about how to evaluate data and mechanical properties

K4 Having an idea of the meaning of the PDE’s of considered physical phenomena’s

K5 Understanding the basic principles of the finite element method

K6 Knowing different simulation techniques

INTELLECTUAL QUALITIES

I1 Choosing the correct method to determine the mechanical properties of a certain structure

I2 Analyse relevant physical effects to take into account for modelling

I3 Choosing the correct simulation approach for a particular system

I4

I5

I6

PROFESSIONAL/PRACTICAL SKILLS

P1 Use FEM simulation software to analyse and design systems with coupled physical phenomena’s.

P2

P3

TRANSFERABLE SKILLS

T1 Appreciate the value of formal description methods as the basis for problem solving.

T2 Know the benefits and limitations of simulation as an engineering tool.

T3 Working effectively in a team

T4 Improving oral and written communication skills

T5 Being able to think and work on different levels of abstraction

T6

CONTENT

- Micro- and Nanomechanics

  Solid state physics
  - dislocation motion in bulk metals
  - dislocation motion in small structures like thin films, pillars, ...
- Measurement techniques
  - Nanoindentation (nano hardness) and its application
    - measuring Young's Modulus, hardness, yield stress and work hardening behavior
    - estimating the influence of creep and strain rate sensitivity
    - determining stress intensity factor
    - nanoindentation and thin films
  - Bulge testing of thin films

- Basic principles of the finite element method
- Modelling techniques
  - Geometry entry
  - Meshing
  - Physical phenomena and appropriate boundary conditions
  - Study types
  - Visualizing simulation results
- Showcase models e.g.:
  - Microresistor beam
  - Electrostatically actuated cantilever
  - RF MEMS switch
  - Micropump
  - Piezoelectric energy harvester
  - Capacitive pressure sensor
  - Surface micromachined accelerometer
  - Capacitive micromotor

LEARNING AND TEACHING METHODS

The syllabus material shall be covered through formal lectures as well as practical work using software tools for programming and simulation.

ASSESSMENT

By formal examination, coursework with assignments.

Coursework:

Mini project: Design, presentation and report.

30%

Examination:

The examination paper will be of 2 hours duration with section A and B consisting overall of 10 questions worth 10 marks each.

70%

30% Coursework 70% Examination

READING LIST

Numerical Simulation of Mechatronic Sensors and Actuators	Kaltenbacher, M.	Springer 978-3-642-09051-6	2010
Process Modelling and Simulation with Finite Element Methods	Zimmerman, W.B.J	World Scientific Publishing 978-9812387936	2004
Multiphysics Modeling Using COMSOL 5 and MATLAB	Pryor, R. W.	Springer 978-1938549984	2015

SUMMARY DESCRIPTION

The module is offered in Germany and covers theoretical and practical aspects of modern MEMS concepts.

MODULE TITLE:	**MICROECONOMICS**
MODULE CODE:	EEE537
MODULE LEVEL:	
CREDIT POINTS:	15
SEMESTER:	2
LOCATION:	Jordanstown (taught in Augsburg, Germany)
PREREQUISITE(S):	
CO-REQUISITE(S):	None
MODULE CO-ORDINATOR(S):	Dr. R. McMurray, Jordanstown School of Electrical and Mechanical Engineering
TEACHING STAFF RESPONSIBLE FOR MODULE DELIVERY:	Professor Dr. Maria Lehner Augsburg University of Applied Sciences
HOURS:	Lecture : 30 Tutorial : 30 Independent Learning : 90
TOTAL EFFORT HOURS:	150
ACADEMIC SUBJECT:	Economics and Business

RATIONALE

Today, a minimum of economic knowledge is required when in a fast changing world decisions have to be made by companies, individuals and national and local governments.

Economic theory is the basis of understanding current political and economic developments and is indispensable for everyone who has to make decisions in any field with an impact on the future of businesses and the economy.

AIMS

The aim of this module is to study the incentives and decision making processes of firms and households and how those impact the market equilibrium and welfare of an economy. Students learn about different market environments such as for example different levels of competition and how those different market environments impact the equilibrium and the welfare in a given market. Students analyze which market environments might give rise to market failure and what policy makers can do in order to address the negative welfare effects of such market failure. The economic theory studied in the course enables students to analyze recent economic developments and to evaluate respective proposed policy measures.

LEARNING OUTCOMES

A successful student will be able to show that he/she can:

KNOWLEDGE AND UNDERSTANDING

- K1 Describe the incentives and decision making processes of firms and consumers.
- K2 Assess the impact of different market environments on the resulting market equilibrium and the welfare of an economy.
- K3 Analyse why certain market environments can lead to market failure and which regulatory measures could be applicable.
- K4 Evaluate the impact of different regulatory measures on the market equilibrium of an economy.
- K5 Evaluate the impact of different regulatory measures on the welfare of an economy.
- K6 Analyse recent economic developments using economic theory.
- K7 Critically evaluate proposed policy measures in light of recent economic developments.

INTELLECTUAL QUALITIES

- I1 Being able to make substantiated proposals and to give answers to current economic issues
- I2 Applying economic theory to actual economic problems and developments

PROFESSIONAL/PRACTICAL SKILLS

- P1 Using the standard economic instruments available to evaluate the economic consequences of current economic and political developments for decision makers
- P2 Developing scenarios for decision makers in business and politics based on varying assumptions about the economic and political environment
- P3 Being able to communicate the results of their own economic analysis for businesses, politics and individuals

TRANSFERABLE SKILLS

- T1 Communicate effectively using oral and written communication.
- T2 Drawing conclusions from different sets of the economic environment by using the methods learned in the course

CONTENT

Introduction to Economics

The concept of utility

Consumer demand

Optimal output decision of firms

Firm supply

Impact of different cost structures of firms on their supply

Market equilibrium

Welfare of an economy

The impact of different market environments on the market equilibrium and the welfare of an economy

Monopolies, duopolies, cartels and collusive behaviour

Introduction to basic game theory

Taxes and subsidies

External effects

LEARNING AND TEACHING METHODS

The syllabus material shall be covered through lectures including case studies and group work as well as coursework using the knowledge developed during the lecture units

ASSESSMENT

By formal examination and coursework in the form of individual assignments.

Coursework:

The assignments will require students to apply the framework of theories covered in the lectures to the analysis of specific cases and problems and deliver a report of their findings.

[K1, K2, K3, K4, K5, K6, K7, I2, P1, P3, T1]

Examination:

The examination paper will be of 1.5 hours and consist of 4-5 questions partly including elements of choice.

[K1, K2, K3, K4, K5, K6, K7, I1, P1, P2, T2]

30% Coursework 70% Examination

READING LIST

Pindyck, Robert S., Rubinfeld Daniel L.: Microeconomics, 2012, 8. Ed., Pearson, Munich

SUMMARY DESCRIPTION

The module is offered in Germany and covers the incentives and decision making processes of different market participants. Students learn to use economic concepts in order to evaluate the consequences of current economic developments for making decisions.

MODULE TITLE:	**MENG FINAL PROJECT**
MODULE CODE:	EEE802 MODULE LEVEL: 7
CREDIT POINTS:	60
MODULE STATUS:	Compulsory
SEMESTER:	2
LOCATION:	Jordanstown
E-LEARNING:	Web Supplement
PREREQUISITE(S):	Completion of Meng Years 1 to 4, or equivalent
CO-REQUISITE(S):	None
MODULE CO-ORDINATOR(S):	Owens, F. Dr.
TEACHING STAFF RESPONSIBLE	Owens, F. Dr.
FOR MODULE DELIVERY:	Plus various supervisors
School of Engineering	
HOURS:	Lectures 12
Tutorial:	12
Independent Study:	576
TOTAL EFFORT HOURS:	600
ACADEMIC SUBJECT:	Electrical/Electronic and Mechanical Engineering

RATIONALE

All students of engineering are required to undertake a major project during the final year of the course, facilitating development of organisational, communicative, technical and design techniques appropriate to the graduate engineer.

AIMS

To equip the student with the skills necessary to carry out a project from conception through to completion of a type relevant to an engineering environment; to plan, monitor, implement and communicate his/her project work.

To give the student an opportunity to carry out a significant investigation into a subject area cognate to the aims of the course.

To develop the ability to work independently and produce solutions demonstrating innovation, initiative and originality.

To provide a measure of integration of the various topics studied on the course.

LEARNING OUTCOMES

A successful student will be able to show that he/she can:

KNOWLEDGE AND UNDERSTANDING

K1 Understand the processes involved in design and problem solving;

K2 Understand the mechanisms for effective project work; planning review and management.

INTELLECTUAL QUALITIES

I1 Apply knowledge gained in an innovative, original way and show initiative;

I2 Design, implement, and evaluate engineering products or systems which are reliable and maintainable.

PROFESSIONAL/PRACTICAL SKILLS

P1 Use resources effectively;

P2 Identify and develop any specific skills needed to ensure a successful project outcome.

TRANSFERABLE SKILLS

T1 Demonstrate the appropriate written and oral skills necessary to effectively communicate project work;

T2 Be able to assess the progress of work against a plan and demonstrate good practice in project organisation and management.

CONTENT

The project will integrate the underlying course material in order to apply engineering knowledge to the design of a practical engineering product or system. There should be opportunities within each project to develop experimental and theoretical work and most of the areas contained within the project should be relevant to topics studied as part of the course. It should integrate one or more of the following aspects into the solution, as appropriate: research, design, quality, implementation, evaluation, reliability, production, and marketing.

TEACHING AND LEARNING METHODS

A series of related lectures will introduce the student to learning resources, technical writing, dissertation presentation and project management. The student will meet with the project supervisor at least once per week to discuss progress, strategy and plans for the subsequent week. The module is web supplemented.

ASSESMENT

The project assessment will be based on the combined assessment of interim and final reports as well as overall project value assessment, and the performance of the student in a viva voce examination. All elements will be assessed using a criterion-based marking scheme and the final report will be assessed blindly by both the project supervisor and the project moderator. If the marks for any element cannot be reconciled between the supervisor and the moderator then the module co-ordinator will arbitrate in order to reach an agreed mark. The viva-voce examination will be conducted by two or three relevant academic staff. There will also be an overall moderation meeting attended by project supervisors and moderators to ensure fair and consistent marking and proper ranking of projects.

Reporting Stages	**Deliverables**
Interim Report (End of week 4, Semester 10)	1. 30 - 40 page report describing Background, Literature Search, Work to Date, Future Plans.
Final Dissertation (End of Semester 10)	2. A ~100-page report describing the complete project.

Each deliverable is an extension and update and integration of the preceding deliverable, taking account of supervisor feedback, change of project direction, project developments etc.

The breakdown of the assessment scheme for the project is as follows:

Coursework 1:

Interim Report 10%

Coursework 2:

Final Report and Overall Project Value Assessment 80%

Coursework 3:

Viva Voce Examination 10%

100% Coursework

READING LIST (recommended)

Rosenberg, B J, 2005, *Spring into Technical Writing: For Engineers and Scientists*, 1st Ed, USA, Addison Wesley.

Van Emden, J, 2005, *Writing for Engineers*, 3rd Ed., USA, Palgrave. Lock, D, 2007, *Project Management,* 9th Ed., UK, Gower Publishing Ltd.

Barker S and Cole, R, 2009, *Brilliant Project Management,* Revised Ed., UK, Pearson Education Limited.

SUMMARY DESCRIPTION

This module is designed to equip students with the appropriate research and project management skills needed to complete an MEng level project and prepares them to be able to contribute positively in their first engineering graduate employment. An ethos of professionalism can be developed and demonstrated in the way that earlier learnt material can be successfully applied in engineering applications; this can continue after graduation and is an essential requirement of a modern practising engineer.

MODULE TITLE:	**EMBEDDED SYSTEMS RTOS DESIGN**
MODULE CODE:	EEE803
MODULE LEVEL	7
CREDIT POINTS:	15
MODULE STATUS:	Compulsory for Electronic Engineering
SEMESTER:	1
LOCATION:	Jordanstown
E-LEARNING:	Web supplemented
PREREQUISITE(S):	EEE5xy Embedded Systems, or equivalent
CO-REQUISITE(S):	None
MODULE CO-ORDINATOR(S):	Amira, A Dr.
TEACHING STAFF RESPONSIBLE FOR MODULE DELIVERY:	Amira, A Dr
HOURS:	Lectures 24 Laboratory 36 Independent learning time: 90
TOTAL EFFORT HOURS	150
ACADEMIC SUBJECT:	EEE

RATIONALE

A knowledge of how to design reliable and real-time embedded systems is a very important asset of today's electronics engineer, particularly for the design of electronic systems with a safety critical aspect.

AIMS

- To provide a detailed knowledge of real-time computing for embedded computer systems
- To illustrate and develop an understanding of the various engineering, scientific and economic tradeoffs necessary in the design of embedded systems
- To understand the principles and the role of embedded systems in real world applications
- To provide familiarity and experience with a range of architectural and programming techniques for embedded engineering systems and their evaluation
- To understand the process of implementing algorithms on embedded systems

LEARNING OUTCOMES

A successful student will be able to show that he/she can:

KNOWLEDGE AND UNDERSTANDING

K1 The student should be able to understand the structure and organisation of advanced embedded systems and their suitability to solve specific engineering problems

K2 The student should be able to critically evaluate the design methodologies and arithmetic techniques used for the implementation of advanced embedded systems

K3 The student should be able to understand how embedded systems work and their use in real world applications.

K4 The student should be able to understand the process of implementing algorithms on embedded systems and their evaluation

INTELLECTUAL QUALITIES

I1 Design, implement and evaluate reliable and real-time embedded systems

I2 Ability to analyse and evaluate the impact of design choices on system performance and the role of embedded systems

I3 Critically evaluate design partitions within software and hardware co-design

PROFESSIONAL7PRACTICAL SKILLS

P1 Source and effectively use information on software and system architectures for the design of reliable real-time embedded systems

P2 Use appropriate computer software and hardware for embedded systems design

P3 Gather, analyse, integrate, and utilise relevant information and data on embedded systems from a variety of sources

TRANSFERABLE SKILLS

T1 Communicate effectively using oral and written communication

T2 Effectively use information technology and associated skills

T3 Demonstrate the ability to perform effectively within a group in the conduct of practical embedded systems group project activity

CONTENT

1. **Introduction to Advanced Digital and Real-time Embedded Systems**

   Introduction, Principles, Applications, ASIC, DSP, FPGAs, GPUs, Microcontrollers, Heterogeneous systems, SoC, Case study: FPGA structure, CLBs, FPGA programming, Programming Languages

2. **Advanced Computer Arithmetic**

   Advanced Two's complement algorithms (Baugh Wooley, Modified Booth Encoder), Conventional Arithmetic, Distributed Arithmetic (DA), bit serial, bit parallel, digit serial, pipelining, parallelism, Systolic Design (SD), Case study: suitability of DA for FPGA Implementation, Inner product, FIR filter Design using DA and Matrix-Matrix multiplication using SD.

3. **Hardware Compilation**

   Definitions, Hardware Description Language HDL, VHDL, hardware compilation using Handel-C), Hardware-Software Co-design principles, DK environment, Handel-C definitions and examples

(PAR construct, Arrays, Signals and Channels), CAD Tools, ISE, Mapping, Placement and Routing, FPGA Editor, Constraint location, timing constraints, Hybrid approaches using VHDL and Handel-C, Interfacing, FPGA and Host communications, DK compiler optimisation,

4. FPGAs and Reconfigurable Computing

Principles, FPGA technology, Design flows for Reconfigurable hardware, DEMOs with applications to DSP, Soft and Hard implementation approach using Micro blaze, Virtex-5 RISC processors, Advanced FPGA devices (case study Virtex), Design security, DCM and clock skew management, Distributed memory design, optimisation of arithmetic techniques on the Virtex FPGA (Efficient mapping and optimisation)

5. Reconfigurable Computing for DSP

What's RC and why interesting? Applications of RC, RC vs standard microprocessor, Dynamic reconfiguration, partitioning, scheduling, optimisation, examples for DSP implementation on FPGA (Discrete Wavelet Transform, FFT, CSC)- This will be supported with the group project activities, Setting-up and FPGA based System

6. Low Power Design from Embedded Systems

Definitions, optimisation techniques, power measurement, power density trends, Case Study: managing power consumption in advanced FPGAs, voltage scaling, impact ofparallelism and pipelining on power consumption, Dynamic power modelling, Static and leakage power, Using XPower tool from ISE for power estimation. Examples of power optimisation for DSP algorithms and applications.

TEACHING AND LEARNING METHODS

The various topics of the subject will be introduced in lectures and reinforced using practical laboratory exercises and the group project activity. The module is web supplemented with examples and reading material.

ASSESSMENT

The module will be assessed using a combination of group project, incorporating practical laboratory, and a written examination.

Coursework: 40%

Group project which includes (report, presentation and demo)

Written Examination: 60%

The examination paper will be closed-book, of duration 2 hours. It will consist of a single section with 3 questions from which students must attempt 2 questions.

READING LIST (recommended)

Arnold S.Berger "Embedded Systems Design: An Introduction to Processes, Tools and Techniques" CMP books.

Uwe Meyer-Baese: Digital Signal Processing with Field Programmable Gate Arrays Second Edition, Springer

R. Hartenstein, H. Gruenbacher: Field-Programmable Logic and Applications - The Roadmap to Reconfigurable Computing; Heidelberg / New York, Springer Verlag, 2000
Keshab K. Parhi: VLSI Digital Signal Processing Systems: Design and Implementation, John Wiley & Sons, 1999

SUMMARY DESCRIPTION

This module enables the student to understand, design and implement reliable and real-time embedded systems.

MODULE TITLE:	**RF DESIGN**
MODULE CODE:	EEE824
MODULE LEVEL	7
CREDIT POINTS:	15
MODULE STATUS:	Optional
SEMESTER:	1
LOCATION:	Jordanstown
E-LEARNING:	Not applicable
PREREQUISITE(S):	The study of electronic circuit design at final- year undergraduate-degree level, or equivalent
CO-REQUISITE(S):	None
MODULE CO-ORDINATOR(S):	Mariotti; D, Dr
TEACHING STAFF RESPONSIBLE FOR MODULE DELIVERY:	Mariotti; D, Dr Burgess, S.J.
HOURS:	Lectures 36 Tutoirals 8 Independent study Including assessment: 106
TOTAL EFFORT HOURS	150
ACADEMIC SUBJECT:	Electronic Engineering
MODULAR SUBJECT	Not applicable

RATIONALE

With the increasing impact of fixed and portable radio systems in the communications industry, it is imperative that engineers have a sound knowledge of modern, relevant RF circuit design techniques and practice.

AIMS

To enhance existing electronic engineering expertise to include high-frequency circuit design. To develop appropriate skills in RF circuit-block specification and discrete component/IC level implementation.

LEARNING OUTCOMES

A successful student will be able to:

KNOWLEDGE AND UNDERSTANDING

K1 Select and use relevant analytic techniques.

K2 Solve detailed problems related to RF carrier synthesis, small and large signal amplification, RF transmission lines and circuit integration methods.

K3 Demonstrate an understanding of system implementation issues, given practical and economic constraints.

INTELLECTUAL QUALITIES

I1 Appreciate the problems associated with RF circuits / systems and the design techniques used to overcome them.

I2 Apply creative thinking to the planning and construction of RF circuits.

I3 Integrate detailed engineering information from a variety of sources, including specialist device datasheets.

PROFESSIONAL/PRACTICAL SKILLS

P1 Research and use engineering information appropriate to specific system design.

P2 Use RF circuit / system simulation tools.

TRANSFERABLE SKILLS

T1 Use the qualitative and quantitative skills acquired in problem solving.

T2 Learn from information presented through a variety of methods – formal classes, directed reading and personal research.

T3 Manage time and supplied resources effectively.

T4 Use appropriate software packages in the acquisition of technical data and communicating information.

CONTENT

Section A: Signal Amplification and Matching

Transmission lines and matching

Types of TEM transmission lines and design equations; network parameters; Q factor; impedance matching and reflections; hybrid and transmission line devices; the Smith Chart and its applications;

HF small signal amplifiers

Small signal design using S-parameters; stability circles; principles of matching RF amplifiers and applied techniques.

RF power amplifiers

Non-linearity in RF amplifiers; gain compression; desensitization and blocking; inter- modulation distortion; PA design; modes of operation and efficiency; reduced conduction angle design; load-pull analysis.

Section B: Signal Generation and Synthesis

RF Oscillators

LC circuits; oscillator classification, stability and spectral purity; use of quartz / ceramic resonators; losses and Q; lumped / distributed elements; output coupling.

Phase locked loops

Linear PLL model; phase detectors, VCOs and loop filters; capture and dynamic performance; the digital PLL; applications.

Frequency synthesis

Synthesis methods; mixing and PLL types; direct-digital synthesis; output noise; hardware considerations and limitations to ensure that the content relates to the aims and intended learning outcomes of the module.

TEACHING AND LEARNING METHODS

This module will be presented through a series of lectures supported by directed reading and tutorial support.

ASSESSMENT

Coursework 1:

A written, library-based assignment covers directed areas of study supplemental to lectures. The assignment is structured to ensure individual contributions from each student andprovides an opportunity to demonstrate an in-depth knowledge of the subject at postgraduate level - 25%

Coursework 2:

A mini-project in which the student will derive component and operational parameters from a practical RF circuit specification provided, selecting active and passive devices / modules as required to give a functional prototype, through either simulation or hardware - 25%

Examination:

There is a 3-hour closed-book examination, with three questions each from sections A and B. Candidates should answer at least two questions from each section; all questions carry equal marks (25 %) - 50%

50% Coursework 50% Examination

READING LIST

Required

Da Silva, E, 2001, High Frequency and Microwave Engineering, B-H Bowick, C,

1995, RF Circuit Design, Newnes.

Recommended

Fooks, E H and Zakarevicius, R A, 1990, Microwave Engineering Using Microstrip Circuits, Prentice-Hall.

Larson, L E (Ed), 1996, RF and Microwave Circuit Design for Wireles Communications, Artech House.

Hagen, J B, 1997, Radio-frequency Electronics: Circuits and Applications, Cambridge Univ. Press.
Carr, J J, 1997, Microwave and Wireless Communications Technology, Newnes. Lee, T H, 2004, The Design of CMOS Radio Frequency Integrated Circuits, 2nd Edition, Cambridge Univ. Press.

SUMMARY DESCRIPTION

This module will equip the student with a deeper knowledge of RF circuit design and provide an understanding of how practical RF devices are implemented in integrated circuit form for deployment in modern communication systems.

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MODULE TITLE:	**MODERN CONTROL SYSTEMS**	
MODULE CODE:	EEE825	
MODULE LEVEL	7	
CREDIT POINTS:	15	
MODULE STATUS:	Optional	
SEMESTER:	1	
LOCATION:	Jordanstown	
E-LEARNING:	Web supplemented	
PREREQUISITE(S):	EEE5xy Mechatronics 2, or equivalent	
CO-REQUISITE(S):	None	
MODULE CO-ORDINATOR(S):	Rao, M P R V, Dr	
TEACHING STAFF RESPONSIBLE FOR MODULE DELIVERY:	Rao, M P R V, Dr Blakley, J J, Dr	
HOURS:	Lectures	36
	Tutoirals	12
	Computer Laboratory	12
	Independent study	90
TOTAL EFFORT HOURS	150	
ACADEMIC SUBJECT:	Electrical/Electronic Engineering	
MODULAR SUBJECT	EEE	

RATIONALE

This is the higher level module in the control systems area in the M. Eng course, building upon the two undergraduate modules in this area. It offers covers some of the recent control systems theories. The M. Eng students will acquire knowledge of the some of advanced control techniques and system stability studies developed from a wide range of Engineering disciplines, and acquire skills in the use of state of the art software tools in the design of controller for realistic industrial processes.

AIMS

The teaching aims of this module are:

1. The student should attain knowledge and understanding of:
    - Modern digital control systems
    - Adaptive control and advanced control concepts

- Industrial robots

2. The student will develop sufficient level of skills in using modern MATLAB toolboxes as the support software in the above areas.
3. The student will acquire a knowledge of research in the control systems area.

LEARNING OUTCOMES

A successful student will be able to:

KNOWLEDGE AND UNDERSTANDING

K1 demonstrate knowledge and understanding of advanced control concepts, adaptive control, Modern digital control systems.

K2 develop sufficient level of skills in using modern MATLAB toolboxes as the support software in the above areas. The student will also develop use of IT skills.

K3 acquire knowledge of research in the control systems are, and demonstrate a knowledge and understanding of digital control systems and adaptive processes.

INTELLECTUAL QUALITIES

I1 describe the performance of digital control and adaptive systems through theuse of analytical and modelling techniques

I2 select and apply quantitative methods and computer software for engineering problem solving.

I3 design and implement digital control and adaptive systems. I4 integrate theory and practice.

I5 report on a practical engineering investigation.

PROFESSIONAL7PRACTICAL SKILLS

P1 prepare, interpret and critically evaluate technical documentation.

P2 source and use engineering information and data from a variety of sources.

P3 use variety of computer applications software.

TRANSREABLE SKILLS

T1 use information technology and associated skills.

T2 demonstrate effective written and oral communication skills.

CONTENT

1. Modern Digital Control Systems

Overview of Digital Control Systems Digital control; continuous, sequencing, information processing capability. Overview of digital control; system architectures, analysis and synthesis. Development, economic considerations and applications. Intelligent control; knowledge-based expert systems, fuzzy logic, neural networks.

Digital Control, Modeling, Analysis and Implementation: Linear systems and the sampling process. Transform analysis. State-variable analysis of discrete-time systems. System modeling and simulation. Digital implementation techniques.

Quantization effects. Sample rate selection.

Design Techniques for Digital Control Systems: Digital control system design techniques employing the z-transform. Direct digital control. Ziegler-Nichols tuning procedure for PID control. Relay auto-tuning techniques. Direct design method of Ragazzini. State approach to control system design. Controllability and state-variable feedback. Observability, observers and state estimator design. Linear discrete-time optimal control. Discrete-time stochastic systems. System identification.

2. **Adaptive Control Systems and Advanced Control Concepts**

Adaptive Control: Motivation for developing adaptive control systems, definitions and classification of adaptive control systems. Indirect adaptive control, self-tuning control systems.

Continuous-Time Adaptive Control Systems: Direct adaptive control, Model Reference Adaptive Control Systems, MRAC: formulation of design problem. Stability approach, First Order System – Structure and Adaptive Laws based on Lyapunov stability theory. Second Order System – Structure and Adaptive Laws based on Lyapunov stability theory.

Computer aided design of adaptive systems: Using simnon and MATLAB packages for the design.

Advanced control Concepts: Fuzzy Logic Control and Neural Network Based Control

3. **Industrial Robots**

Elements: manipulator, actuators, end-effectors, control systems.

Kinematics: degrees-of –freedom, coordinate systems, forward and inverse kinematics.

Control: hierarchy of control, trajectory planning, coordinate transformations, axes control systems.

LEARNING AND TEACHING METHODS

In order to meet the learning outcomes, the teaching methods will involve formal lecture, tutorials and laboratory sessions. MATLAB software at laboratory PCs will be used for gaining practical, computer supported design skills.

ASSESSEMENT

Coursework:

Coursework assessment will be based on three assignments (each 1/3 of 100 marks) which would involve laboratory notebook, computer-based design and library-based work. The development of research skills is tested using a written report - 50%.

Examination:

Written examination consists of a formal 3 hours examination at the end of semester - 50%. 50%

Coursework 50% Examination

READING LIST

Recommended

Jacquot, G. J, 1995, Modern Digital Control Systems, 2nd Ed., CRC Press. Paraskevopoulos P N, 1996, Digital Control Systems, Prentice Hall

Narendra K S and Annaswamy, A M, 2009, Stable Adaptive Systems, Dover Publications Inc.

Stefiani, S, Hostetter, S, 2001, Design of Feedback Control Systems, 4th Ed., OUP USA.
Astrom, K and Wittenmark, 2008, Adaptive Control, 2nd Ed.,, Dover Publications Inc. Kecman, V, 2001, Learning and Soft Computing, MIT Press
Coiffet, P, 1983, Robot Technology, Modeling and Control Vol. 1, Kogan PageCraig, J C, 2004, Introduction to Robotics: Mechanics and Control, 3rd Ed, Pearson Education.
McCloy, Dand M. Harris, 1986, Robotics: An Introduction, Chapman Hall.
Sciavicco, L and Siciliano, B, 2000, Modelling and Control of Robot Manipulators, 2nd Ed., Springer.

SUMMARY DESCRIPTION

This module covers some advanced control theories including: digital control and adaptive control, and includes aspects of control research.

MODULE TITLE:	**DIGITAL SIGNALPROCESSING**
MODULE CODE:	EEE826
MODULE LEVEL	7
CREDIT POINTS:	15
MODULE STATUS:	Optional Compulsory for Electronics pathway
SEMESTER:	1
LOCATION:	Jordanstown
E-LEARNING:	Web supplemented
PREREQUISITE(S):	BME501, or equivalent
CO-REQUISITE(S):	None
MODULE CO-ORDINATOR(S):	Owens, F. J. Dr
TEACHING STAFF RESPONSIBLE FOR MODULE DELIVERY:	Owens, F. J. Dr
HOURS:	Lectures 36 Tutorials 12 Laboratory 12 Independent study 90
TOTAL EFFORT HOURS	150
ACADEMIC SUBJECT:	Electrical/Electronic Engineering
MODULAR SUBJECT	EEE

RATIONALE

The move from analogue to digital processing of signals in many application areas of electronics engineering continues to develop rapidly. An knowledge of Digital Signal Processing (DSP) is virtually essential for a practising electronics engineer.

AIMS

To enable the student to understand, design and implement signal processing algorithms and systems.

LERANING OUTCOMES

A successful student will be able to:

KNOWLEDGE AND UNDERSTANDING

K1 Demonstrate a comprehensive knowledge and understanding of

- signal sampling,
- anti-aliasing and anti-imaging filtering
- digital filter design
- spectral estimation techniques
- real-time signal processing
- a variety of digital signal processing (DSP) techniques and algorithms

K2 Recognise and analyse DSP algorithm specifications and design criteria and be able to plan strategies for their implementation.

K3 Employ effectively modern DSP methodologies and tools for the specification, design, implementation and critical evaluation of DSP algorithm solutions.

INTELLECTUAL QUALITIES

I1 Be creative in the solution of DSP problems and in the development of designs.

I2 Plan, conduct and report on a practical DSP group mini-project.

I3 Communicate effectively in oral and written form ideas, proposals and designs for DSP algorithms using rational and reasoned arguments.

PROFESSIONAL7PRACTICAL SKILLS

P1 Source and effectively use information on DSP techniques and algorithms.

P2 Use appropriate DSP computer applications software.

P3 Gather, analyse, integrate, and utilise DSP information and data from a variety of sources.

TRANSFERABLE SKILLS

T1 Communicate effectively using oral and written communication.

T2 Effectively use information technology and associated skills.

T3 Demonstrate the ability to perform effectively within a group in the conduct of a practical DSP project.

CONTENT

1. Front-End and Back-End Processing:
   Signal sampling; ADC quantisation and aperture time; anti-aliasing filter design; digital to analogue conversion; anti-imaging filters.
2. Digital Filtering:
   IIR and FIR filter design using the pole-zero placement bilinear transform and impulse invariant transform; realisation structures; effects of finite precision arithmetic.
3. Spectral Estimation:
   Fast Fourier Transform; continuous and discrete random processes, power spectral density; periodogram method; parametric methods; AR and ARMA models.
4. System Implementation:

DSP families; architectures; real-time algorithm implementation.

5. Applications:
Biomedical signal processing; speech analysis; image processing; speech and video compression.

TEACHING AND LEARNING METHODS

The various topics of the subject will be introduced in lectures and reinforced using problem- solving tutorial classes, practical laboratories and mini-project work.

Students will be split into groups of 2 or 3 and assigned a mini-project, which will generally require the design and evaluation of digital signal processing algorithms and their implementation in real-time on relevant hardware. The module is web supplemented.

ASSESSMENT

The module will be assessed using a combination of continuous assessment, incorporating group project work, and a written examination.

Coursework:

Group Mini-Project	50%
Written Examination:	50%

The examination paper will be closed-book, of duration 3 hours, and will consist of two sections A and B. Section A will consist of 6 compulsory short questions worth 6 marks each, with no element of choice. Section B will contain 6 long questions, worth 16 marks each and the student will be required to answer four of these.

50% Coursework 50% Examination

READING LIST

Recommended

Proakis J G and Manolakis, D K, 2009, Digital Signal Processing: Principles, Algorithms and Applications, 4th Ed.,UK, PEARSON Prentice Hall.

Proakis J G and Manolakis, D K, 2007, Digital Signal Processing Using MATLAB, 1st Ed., UK, PEARSON Prentice Hall.

Ifeachor, E and Jervis, B W, 2002, Digital Signal Processing: A Practical Approach, 2nd Edition, UK, PEARSON Prentice Hall.

Stearns, S D, 2003, Digital Signal Processing With examples in MATLAB, 1st Edition, Florida, CRC Press.

Owens, F J, 1993, Signal Processing of Speech, 1st Ed., London, Macmillan.Lyons, R G, 2004, Understanding Digital Signal Processing, 2nd Ed., USA, Prentice-Hall PTR

Smith, S, 2003, Digital Signal Processing: A Practical Guide for Engineers and Scientists, 1st Ed., UK, Elsevier Science and Technology.

Mulgrew, B, Grant, P M and Thompson, J, 2002, Digital Signal Processing: Concepts and Applications, 2nd Ed., UK, Palgrave Macmillan.

Oppenheim, A, Schafer, R W and Buck, J R, 2003, Discrete-Time Signal Processing,
3rd Ed., USA, Pearson Prentice Hall.

Dahnoun, N, 2000, Digital Signal Processing Implementation Using the TMS320C6000 DSP Platform, 1st Ed., UK, PEARSON Prentice Hall.

SUMMARY DESCRIPTION

This module enables the student to understand, design apply, and evaluate digital signal processing algorithms.

MODULE TITLE:	**PRODUCT INNOVATION**
MODULE CODE:	EEE828
MODULE LEVEL	7
CREDIT POINTS:	15
MODULE STATUS:	Compulsory
SEMESTER:	1
LOCATION:	Jordanstown
E-LEARNING:	Web supplemented
PREREQUISITE(S):	Completion of Level 4, 5 and 6 studies
CO-REQUISITE(S):	None
MODULE CO-ORDINATOR(S):	McKeag, D. Professor
TEACHING STAFF RESPONSIBLE FOR MODULE DELIVERY:	McKeag, D. Professor
HOURS:	Lectures 36 Tutorials 36 Independent study 78
TOTAL EFFORT HOURS	150
ACADEMIC SUBJECT:	Electrical/Electronic Engineering
MODULAR SUBJECT	EEE

RATIONALE

The engineering graduate is required to participate in the management and control of the total technology-based innovation activity within a modern industrial and commercial environment. This module creates knowledge and understanding of the process, skills and techniques required in generating innovation products, processes and systems. The teaching and learning is largely through the activity of solving an industry-focused client generated brief.

AIMS

The aim of this module is to provide participants with the capability to improve the competitiveness of their companies through new product and/or process innovation. Emphasis is placed on:

- Teamwork
- Interdisciplinary Management
- Concurrent Engineering Principles
- Technical Appraisal
- Commercial Appraisal
- Management Evaluation and review Techniques

LEARNING OUTCOMES

A successful student will be able to:

KNOWLEDGE AND UNDERSTANDING

K 1 Develop a comprehensive knowledge and understanding of the principles, theories and practice in their chosen area of specialisation.

K2 Recognise and analyse criteria and specifications appropriate to specific problems and plan strategies for their solution.

K3 Employ effectively modern methodologies and tools for the specification, design, critical evaluation and implementation of solutions in the chosen specialist area.

K4 Analyse the extent to which a designed system meets the criteria defined for its current deployment and future evolution.

K5 Communicate effectively ideas, proposals and designs to a range of audiences, using rational and reasoned arguments, orally, in writing and electronically.

K6 Comprehend the professional, legal, moral, environmental and ethical issues involved in the exploitation of resources.

INTELLECTUAL QUALITIES

I1 Analyse complex problems and formulate solutions.

I2 Be creative in the solution of problems and in the development of designs and systems.

I3 Integrate specialist theory and practice with particular emphasis on application, design, quality, commercial and management studies.

I4 Gather, analyse, integrate and utilise information and data from a variety of sources.

I5 Conduct and report on activities in the chosen specialist area.

I6 Plan, conduct and report a major programme of original research or implementation of new and advanced processes, designs, procedures, technologies into industry.

PROFESSIONAL/PRACTICAL SKILLS

P1 Generate innovative designs for products, systems or processes to fulfil new needs.

P2 Source and effectively use specialist information.

P3 Utilise appropriate industry standard computer applications software.

P4 Perform effectively within a team environment and have the ability to recognise and utilise individuals' contributions in-group processes.

P5 Use management skills to plan and organise work groups and projects.

P6 Write reports, using coherent arguments, for various audiences including management, technical users or the academic community.

TRANSFERABLE SKILLS

T1 Learn in both familiar and unfamiliar situations making effective use of information search and retrieval skills and of learning resources.

T2 Communicate effectively using appropriate media and with a variety of audiences.

T3 Apply appropriate modelling skills to solve problems in the chosen specialism.

T4 Effectively use information technology and associated skills.

T5 Use associate thinking techniques to move knowledge and intellectual property from one specialism to another.

T6 Develop the facility for independent learning, open-mindedness, and the spirit of critical enquiry.

T7 Appreciate the need for continuing professional development in recognition of the requirements of Life Long Learning.

INNOVATION

E1 Critically analyse key theories of innovation, intrapreneurship, innovation process and the environments in which innovation flourishes, including evaluating the role of the lone innovator and the innovation team in new product creation, in the development of established enterprises and in new product development activity.

E2 Critically examine the components of a new venture/project plan and aspects of the planning process.

E3 Critically examine the importance of the opportunity and latent need in the context of innovation processes, the role of creativity and user centred design in helping identify and specify latent need and new product opportunities and the challenges of protecting new ideas.

E4 Experiment with creativity in seeking solutions to complex problems, in the development of new products, processes and systems.

E5 Evaluate the potential of alternative innovative concepts and ideas using appropriate evaluation techniques.

E6 Critically examine and organise effectively the different resources needed to fully exploit the potential of a potential innovation, including material resources, physical resources, human and financial resources.

E7 Integrate innovation related concepts, theory, approaches and techniques into the development of an effective strategic plan for new product, process or systems innovation in the context of a new or existing business.

CONTENT

- Strategies for new product design, development and manufacture.
  Principles and practice of simultaneous engineering.
- Multidisciplinary design development and interface management.
- Organising new product design and development to include techniques such as; TQM, QFD, IDEF, EDM, FMEA,
- DFMA, Robust Design, Lean Design, Taguchi methods, Product ability analysis and Parallel Working, Design change management, Describing and modelling the design/development process, Teamwork, Project Management, and effective use of CADCANVCAE.
- Business planning to include generation of; Product plans, Resources plans, Financial plans, Management plans.
- Role of marketing in new product design, development and technological innovation.

LEARNING AND TEACHING METHODS

Teaching methods will include lecture, discussion, and case study as appropriate. These will be delivered by both academic staff and invited key speakers from industry. There will also be practical sessions where typically each company decides whether or not it is an existing or a new company. They will form an organisation and structure for their hypothetical company and each individual will assume the role of an executive director departmental head/specialist.

Each "company" is required to adopt the policy that it is committed to new product and/or process development allied to innovation in new technology. The company will be required to identify a new innovative product or process and develop design through the concept phase and into some detail. Emphasis will be on multidisciplinary activity and interface management, incorporating where relevant skills and techniques introduced in the lecture context.

All project assignments will be based on a live industrial problem, and for this reason each module will have the active participation of the manufacturing company on whose problem the project is based.

Key objectives to be incorporated into the delivery of the module include:

- To teach the skills and techniques which are important in design, development and innovation.
- To provide delegates with knowledge and understanding of design, development and innovation and why these are important.
- To provide delegates with training and experience in design development and innovation.
- To teach the importance of self development based on directed objective based work, with particular emphasis on knowledge gained from investigative information based research.

ASSESSEMENT

Assessment will take place roughly 2 weeks following module completion.

As assessment, each "company" will submit a report outlining the technical feasibility and commercial viability of their project proposal. The report will comprise clearly identifiable individual sections submitted by each executive director, and representatives of the department function under his control.

Each “Company“will also be required to provide a 60 to 90 minute presentation to the board outlining their proposal and support/reservations etc with regards to the project/company.

(100% coursework)

READING LIST

Recommend

Armstrong, K P, Saunders, G, and Wong, J and V, 1999, Principles of Marketing, Second Europlan Edition, Prentice Hall.

Pugh, S,1990, Total Design.

Walsh, V et al, 1993, Winning by Design, Blackwell Business.

Henry, J and Walker, D, 1993, Managing Innovation, Sage Publications. Design Council, 1993, Design and the Economy.

Kotler, 1999, Marketing Management: Analysis, Planning and Control, Prentice Hall.

SUMMARY DESCRIPTION

To provide participants with the capability to improve the competitiveness of companies through new product and/or process innovation. A major team design project is addressed derived from a real problem from within a local manufacturing company. Material covered is supported through tutorial lecture sessions as appropriate.

MODULE TITLE:	**MICRO AND NANOSCALE FABRICATION**
MODULE CODE:	EEE832
MODULE LEVEL	7
CREDIT POINTS:	15
MODULE STATUS:	Optional
SEMESTER:	1/2
LOCATION:	Jordanstown
E-LEARNING:	Web supplemented
PREREQUISITE(S):	None
CO-REQUISITE(S):	None
MODULE CO-ORDINATOR(S):	Papakonstantinou, P Professor
TEACHING STAFF RESPONSIBLE	
FOR MODULE DELIVERY:	Byrne, A Dr. Papakonstantinou, P Professor Maguire, P. Professor
HOURS:	Lectures 30 Practicals/Demonstrations 6 Independent study 114
TOTAL EFFORT HOURS	150
ACADEMIC SUBJECT:	Nanotechnology
MODULAR SUBJECT	EEE

RATIONALE

Nanotechnology is an enabling technology by which existing materials can acquire novel properties and functionalities, making them suitable for applications varying from structural and functional to advanced biomedical. Advanced fabrication techniques are enabling scientists and engineers to build structures atom-by-atom or molecule-by-molecule. The new atomistic analyses and advanced characterisation methods have been pioneered by transmission electron microscopy that has enhanced the understanding and control of both micro and nanostructures. This course lays the foundation for further study in the area of micro and nano-fabrication of materials and includes elements from surface science, nanoscience, plasmas and thin films, biosensors, tissue engineering and biomaterials

AIMS

To provide students with a detailed working knowledge of the fabrication of micro and nanosystems.

LEARNING OUTCOMES

A successful student will be able to:

KNOWLEDGE AND UNDERSTANDING

K1 Develop a comprehensive knowledge of the principles and methods of micro and nanotechnology, in order to design and fabricate micro and nanostructures.

K2 Develop a working knowledge of the different materials and fabrication processes used in micro and nano-systems technology.

INTELLECTUAL QUALITIES

I1 Develop a working knowledge of how different techniques can be used to characterise the materials used and devices made in micro and nano-systems technology.

PROFESSIONAL/PRACTICAL SKILLS

P1 Develop a working knowledge of how the different fabrication processes can be integrated together to make complete fabrication processes.

TRANSFERABLE/KEY SKILLS

T1 Develop skills for the operation of sophisticated apparatus like ion-beam techniques, scanning electron microscopes, atomic force microscope etc.

T2 Appreciate issues related with setting up the manufacture of micro and nanodevices.

CONTENT

- Processing of substrate materials and their crystallography (eg Si, GaAs and SOI).
- Fundamentals of DC and RF plasmas for deposition, etching and surface modification.
- Thin film deposition methods: Physical Vapour Deposition (Sputtering, evaporation, MBE, PLD etc), Chemical methods (CVD, MOCVD, CSD, Sol-gel).
- Dry etching technologies for metals, semiconductors and insulators.
- Silicon fabrication processes.
- Carbon nanotubes and fabrication methods.
- Micro and nanosystems fabrication techniques.
- Advanced micro and nanolithography.
- Pressure sensors and packaging. MEMS performance and evaluation.
- Thick film sensors, rapid prototyping and micro ECM and EDM.
- Integration of micro and nanosystems with electronics and the exploitation of micro and nanosystems.
- Manufacturing issues in micro and nanosystems technology.
- Clean room technology and practice.
- Analytical models for micro and nanosystems technology.
- Practical classes.

LEARNING AND TEACHING METHODS

In this module, fundamental concepts are presented via lectures and workshops/tutorials. Consolidation and extension of this knowledge is provided via directed learning and the mini- project assignment, which seeks to relate theory to practice.

ASSESSMENT

Continuously Assessed (CA)

This comprises a mini-project assignment which will help the students to apply their knowledge to practical issues. 50%

Set Examination

A 3-hour paper with between 5 and 8 questions in which there will be and element of choice - 50%

50% Coursework 50% Examination

READING LIST

Required

Campbell, S, 2001, The Science and Engineering of Microelectronic Fabrication, 2nd Edition, Oxford University Press.

Madou, M J, 2002, Fundamentals of Microfabrication: The Science of Miniaturization, 2nd Edition, CRC Press.

Meyers, M, Ritchie, R, Sarikaya, M, (eds), 2003, Nano and Microstructural Design of Advanced Materials, Elsevier.

Recommended

Morgan, D V and Board, K, 1996, An Introduction to Semiconductor Microtechnology, 2nd Edition, John Wiley and Sons.

Bai Chunli, 2000, Scanning Tunneling Microscopy and is Applications, Springer Series in Surface Sciences. Vol, 32.

Pique, A. Chrisey, D, (eds), 2002, Direct Write Technologies for Rapid Prototyping, Elsevier, Academic Press.

Jaeger, R C., 1988, Introduction to Microelectronic Fabrication, Addison-Wesley Publishing Co.

Bechstedt, F, 2003 Principles of Surface Physics, Springer-Verlag.

Bhushan, B, (ed), 2004, Springer Handbook of Nanotechnology, Springer-Verlag. Ibach, H, Leith, H, 2003, Solid State Physics: An Introduction to Principles of Materials Science 3rd Edition, Springer-Verlag.

Rimini, E, 1994, Ion Implantation: Basics to Device Fabrication, Kluwer Academic Publishers.

Tsakalakos, T, Ovid'ko I.A, Vasudevan A K, (eds), 2003, Nanostructures: Synthesis, Functional Properties and Applications, Kluwer Academic, Publishers

Ohring, M., 2002, Materials Science of Thin Films, Elsevier Academic Publishers Press.

SUMMARY DESCRIPTION

The course provides an in depth knowledge of micro and nanofabrication techniques using elements from surface science, nanoscience and nanotechnology, plasmas and thin films, biosensors, tissue engineering and biomaterials.

MODULE TITLE:	**MECHANICS OF SHEET METAL FOAMING**
MODULE CODE:	MEC878
MODULE LEVEL	7
CREDIT POINTS:	15
MODULE STATUS:	Optional
SEMESTER:	1
LOCATION:	Jordanstown
E-LEARNING:	Web supplemented
PREREQUISITE(S):	None
CO-REQUISITE(S):	None
MODULE CO-ORDINATOR(S):	Leacock, A. G. Dr.
TEACHING STAFF RESPONSIBLE FOR MODULE DELIVERY:	Leacock, A. G. Dr
HOURS:	Lectures 24
	Practical 6
	Tutorial 6
	Independent study 114
TOTAL EFFORT HOURS	150
ACADEMIC SUBJECT:	Mechanics of sheet metal forming
MODULAR SUBJECT	MEC

RATIONALE

Mechanics of sheet metal forming and metal forming processes are presented as a single subject thus providing a basis for analytical solutions to metal forming problems.

AIMS

To provide students with the ability to analyse metal forming processes using basic mathematics.

LEARNING OUTCOMES

A successful student will be able to show that he/she can:

KNOWLEDGE AND UNDERSTANDING

K1 Demonstrate a comprehensive knowledge and understanding of mathematical and scientific principles specific to the mechanics of sheet metal forming

K2 Demonstrate a comprehensive knowledge and understanding of research methods and their application to sheet metal forming

INTELLECTUAL QUALITIES

I1 Identify, classify and describe engineering metallic materials using appropriate analytical and modelling methods

I2 Apply quantitative methods and computer software in problem solving

I3 Integrate the theory of mechanics of sheet metal forming and practical observation of real industrial forming processes

I4 Critically evaluate a sheet metal forming processes from an analytical perspective

PROFESSIONAL/PRACTICAL SKILLS

P1 Plan and conduct laboratory tasks for the assessment of metallic material formability

P2 Devise experiments and critically evaluate results and data from the literature

P3 Obtain and integrate information from a variety of sources

TRANSFERABLE SKILLS

T1 Demonstrate effective technical writing and oral presentation skills

CONTENT

- Determination of Material Properties
- Sheet Deformation Processes including Plane-Stress
- Simplified Stamping Analysis
- Combined Bending and Stretching of Sheet
- Introduction to FEA Applied to Metal Forming

LEARNING AND TEACHING METHODS

The module will be founded on comprise of lectures for the delivery of the basic theories, while providing opportunities for group discussion of the more complex issues.

Practical sessions will be used to explain the test requirements for mechanical metallurgy. Students will also be expected to devise and perform a material formability test during these sessions. These results will then be used to create a research paper based on the process.

Additional support will be provided in the form of tutorials. These sessions will be used to cover the additional class problems.

ASSESSMENT

Coursework 1: 40 %

Students will be expected to submit a properly referenced seminar paper. The initial paper should be submitted in week 5. Referee's comments will be returned to students by week 8, after which the students are expected to submit the final version by week 10. Each paper will be based upon test results from the practical session covering a topic from the selected text and should show evidence of critical assessment of the material and application to a specific industrial forming process.

Coursework 2: 10 %

Students will be expected to give a short 15 minute presentation on their paper, followed by five minutes for questions. The presentations will be given to the entire class and all tutors in seminar sessions during weeks 11 and 12.

Examination: 50 %

The exam will consist of a 2 hour written examination at the end of the semester. This exam will cover all the material delivered in the lectures and tutorials. Students will be given a choice of answering four questions from six.

50% Coursework 50% Examination

READING LIST

Required

Marciniak, Z, (2003) Mechanics of Sheet Metal Forming 2nd Ed., Butterworth – Heineman, 2003

Recommended

Hosford, W F, (2005) Mechanical Behaviour of Materials, Cambridge University Press, 2005
Hosford, W F, (2005) Physical Metallurgy, Taylor and Francis, 2005
Bowman, K, (2004) Mechanical Behaviour of Materials, John Wiley and Sons, 2004
Banabic, D, et al (2000) Formability of metallic materials: plastic anisotropy, formability testing, forming limits , Berlin; London: Springer, 2000
Suchy, I, (1998) Handbook of die design, , McGraw-Hill, 1998
Metals Handbook, Vol 14, 8th Ed., (Online resource accessible from Ulster IP only)

SUMMARY DESCRIPTION

An introduction to the theory of engineering plasticity applied to common sheet metal forming processes. The relevant theories are presented and their application to real industrial processes are emphasised.