Twinning Engineering Programmes(TEP)

(Thammasat University and the University of Nottingham)

Electrical Engineering / Electronic and Computer Engineering

(Revision 2004)

Electrical engineering is fundamental to many fields of high technology such as electronic design and information technology as well as the efficient use of energy. It is likely to continue to grow and offer worthwhile careers to well qualified graduates.

The undergraduate curriculum of the Department of Electrical Engineering provides preparation in the basic electrical and physical sciences, electronics, computer science and engineering, information processing, control as well as humanities and social sciences.

The Department offers programme of study in communications and electronics, and electrical power and control.

Overall credits : 149 credits

Curriculum Outline	Total credits		
	TU	NU*	Total
Total credit requirement	89	60	149
1. General Courses	48	0	48
1.1 Part I: General Basic Courses required by Thammasat University	21	0	21
- Humanities	3	0	3
- Social Sciences	3	0	3
- Languages	9	0	9
- General Sciences and Mathematics	6	0	6
1.2 Part II: Engineering Sciences and Mathematics	27	0	27
2. Engineering Courses	41	54	95
2.1 Core Courses	14	0	14
2.2 Major Courses	27	54	81
2.2.1 Compulsory Courses	27	24	51
2.2.2 Elective Courses**	0	30	30
3. Free Electives***	0	6	6

Notes: * The numbers of credits shown in the table represent the credits counted at Thammasat University. The parenthetical numbers represent the credits counted at the University of Nottingham where 10 credits equivalent to 3 credits at Thammasat University.

** Elective Courses at the University of Nottingham

*** Select any courses offered by the University of Nottingham

* This curriculum may be revised if necessary .

Details of Curriculum

At Thammasat

1. Part I: General Basic Courses required by Thammasat University 48 credits

1.1 Part I Total 21 credits

1.1.1 Humanities

TU 110 Integrated Humanities (3 credits)

1.1.2 Social Sciences

TU 120 Integrated Social Sciences (3 credits)

1.1.3 Languages totally 7 courses

1 compulsory Thai course :

TH 160 * or TH 161 (3 credits)

* for foreigners or anyone who receives a permission from the Department of Thai

6 compulsory English courses :

EL 171 English Course II (3 credits)

EL 172 English Course III (3 credits)

**EL 214 Communicative English I

**EL 215 Communicative English II

**EL 314 Communicative English III

** Credits are not counted.

1.1.4 General Sciences and Mathematics

TU 130 Integrated Sciences and Technology (3 credits)

CN 208 Introductory Computer Programming (3 credits)

1.2 Part II Total 27 credits

Engineering Sciences and Mathematics 27 credits

MA 111 Fundamentals of Calculus (3 credits)

MA 112 Analytic Geometry and Applied Calculus (3 credits)

MA 131 Applied Linear Algebra (3 credits)

MA 214 Differential Equation (3 credits)

MA 251 Numerical Methods and Application (3 credits)

SC 124 Chemistry for Engineers (3 credits)

SC 133 Physics for Engineers I (3 credits)

SC 134 Physics for Engineers II (3 credits)

SC 174 Chemistry for Engineers Laboratory (1 credit)

SC 183 Physics for Engineers Laboratory I (1 credit)

SC 184 Physics for Engineers Laboratory II (1 credit)

2. Part II : Engineering Course 41 credits

2.1 Core Courses 14 credits

Students must complete totally 14 credits of core course below.

IE 121 IE 261 CE 100 CE 101
CE 202 ME 111

2.2 Major Courses 27 credits

Students must complete totally 27 credits below.

LE 200 LE 201 LE 202 LE 210 LE 220
LE 221 LE 230 LE 301 LE 320 LE 345

At NU

Total credit requirements at NU 60 credits

1. Engineering Courses : 54 credits
2. Free Electives : 6 credits

(The numbers of credits shown in the table represent the credits counted at Thammasat University. The parenthetical numbers represent the credits counted at the University of Nottingham where 10 credits equivalent to 3 credits at Thammasat University.)

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Course Planning

Year 1

Semester 1

Course Number	Title	Credit (lecture-lab-self study)	Prerequisite
CE 100	Ethics for Engineers	0(0-0-0)	-
CE 101	Introduction to Engineering Profession	2(2-0-4)	-
MA 111	Fundamentals of Calculus	3(3-0-6)	-
ME 111	Engineering Graphics	3(2-3-2)	-
IE 121	Engineering Materials I	3(3-0-6)	-
SC 133	Physics for Engineers I	3(3-0-6)	-
SC 183	Physics for Engineers Laboratory I	1(0-3-0)	Used to study and study together with SC 133
EL 171	English Course II	3(3-0-6)	-
TU 130	Integrated Sciences and Technology	3(3-0-6)	-
	Total	21(19-6-36)	

Semester 2

Course Number	Title	Credit (lecture-lab-self study)	Prerequisite
TH 161 Or TH 160*	Thai Usage I Or Thai Usage	3(3-0-6) 3(3-0-6)	-
EL 172	English Course III	3(3-0-6)	EL 171
SC 124	Chemistry for Engineers	3(3-0-6)	-
SC 174	Chemistry for Engineers Laboratory	1(0-3-6)	-
MA 112	Analytic Geometry and Applied Calculus	3(3-0-6)	MA 111
MA 131	Applied Linear Algebra	3(3-0-6)	-
SC 134	Physics for Engineering II	3(3-0-6)	Used to study SC 133
SC 184	Physics for Engineers Laboratory II	1(0-3-0)	Used to study and study together with SC 134
	Total	20(18-6-42)	

* This curriculum may be revised if necessary.

Year 2

Semester 1

Course Number	Title	Credits (lecture – lab – self study)	Prerequisite
MA 214	Differential Equation	3 (3-0-6)	MA 112
CN 208	Introductory Computer Programming	3 (3-0-6)	-
IE 261	Engineering Statistics	3 (3-0-6)	-
LE 220	Electrical Circuit Analysis	3 (3-0-6)	SC 134
LE 201	Basic Electrical Engineering Design I	2 (1-3-2)	-
CE 202	Engineering Mechanics-Statics	3 (3-0-6)	SC 133
TU 110	Integrated Humanities	3 (3-0-6)	-
EL 214	Communicative English I	0 (0-4-2)	EL 172
	Total	20(19-7-40)	

Semester 2

Course Number	Title	Credits (lecture – lab – self study)	Prerequisite
LE 221	Basic Electronic Circuits and Devices	3 (3-0-6)	LE 220
LE 210	Signals and Systems	3 (3-0-6)	-
LE 202	Basic Electrical Engineering Design II	2 (1-3-2)	LE 201
LE 200	Electromagnetic Theory	3 (3-0-6)	SC 134 , MA 112
MA 251	Numerical Methods and Application	3 (3-0-6)	MA 214
TU 120	Integrated Social Sciences	3(3-0-6)	-
LE 320	Digital Circuits Design	3 (3-0-6)	-
EL 215	Communicative English II	0 (0-4-2)	EL 214 (or can be taken in the same semester as EL 214 or with the instructor's permission
	Total	20(19-7-40)	

* This curriculum may be revised if necessary.

Year 3

Semester 1

Course	Title	Credits (lecture – lab – self study)	Prerequisite
LE 345	Microprocessor Systems Design	3 (3-0-6)	LE 320
LE 301	Advanced Electrical Engineering Design I	2 (1-3-2)	LE 202
LE 230	Electrical Machines I	3 (3-0-6)	LE 220
EL 314	Communicative English III	0 (0-3-3)	EL 215 (or can be taken in the same semester as EL 215 or with the instructor's permission
	Total	8(7-6-17)	

* This curriculum may be revised if necessary.

Course at University of Nottingham (Semester 6-9)

Course Number	Title	Credits
	Semester 6	
H62 SP1	Signal Processing	10
H52 EA3	Group Design and Build Project	10
xxx xxx	Technical Electives	30
		50

Semester 7

H62 DE2	Digital Electronics 2	10
H52 FWA	Fields, Waves & Antennas	10
H62 SE2	C Programming for Engineers	5
H62 ANC	Analogue Circuits	5
xxx xxx	Technical Electives	20
		50

Semester 8

H53 PJ3	3rd Year Project	30
	Or	
H53 GP3	3rd Year Group Project	
xxx xxx	Technical Elective	10
xxx xxx	Free Elective	10
		50

Semester 9

xxx xxx	Technical Electives	40
xxx xxx	Free Elective	10
		50

Technical Electives

G52CCN	H54ACD	H54CEM	H54IMD	H54PQE
H54SPD	H5BCT1	H5BPE1	H5CCT2	H5CEDR
H5CEMA	H5CPE2	H5CPNW	H62CM1	H62OOP
H62PEL	H62TCS	H64CM3	H64HDL	H64HSD
H64INM	H64SP2	H6CCM2	H6CCSA	H6CEN1
H6COPT	H6CSE3	H6CSSD	H6CTCE	H6CVLS
H6CIND				

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Electrical Engineering

Course description at Thammasat University
Course description of the university's general program

TU 110 Integrated Humanities **3(3-0-6)**

Prerequisite : -

To study different aspects of man from the beginning till now, such as beliefs, intellectual developments and creativities. And how to survive in this changeable world with the problems that we are facing in this globalization technomania society through concentration on one's inner self.

TU 120 Integrated Social Sciences **3(3-0-6)**

Prerequisite: -

A study of the origin of social sciences in the modern world, the separation of social science from science, the acceptance of scientific paradigm for the explanation of social phenomenon. Analysis of significant disciplines, concepts and theories in social science by pointing out their strengths and weaknesses when applied to social problems. Analysis of current issues with the application of social theories so that each issue is understood from the individual perspective, group perspective and macro - social, national and world perspectives.

EL 171 English Course II **3(3-2-6)**

Prerequisite: -

This intermediate course aims to develop the four English skills-listening, speaking, reading and writing. Students are required to have more practice in listening comprehension, reading various printed materials and writing short paragraphs.

EL 172 English Course III **3(3-2-6)**

Prerequisite: EL 171

This advanced course aims to develop student's English skills. Students are required to have more practice in listening to news and dialogues, reading more complex passages, and writing various types of paragraphs.

EL 214 Communicative English I **0(0-4-2)**

Prerequisite: EL 172

In this intermediate course, students will practice the four skills through academic activities such as discussions and group work. This will enable students to communicate effectively with native English speakers.

- Speaking : to improve pronunciation of problematic sounds
- Writing : to study essay writing such as how to write an introduction and a conclusion
- Listening : to practice listening to problematic sounds for Thai students
- Reading : to study vocabulary and practice different reading strategies such as reading for the main idea and critical reading

Grading criteria : S (Satisfactory) or U (Unsatisfactory)

EL 215 Communicative English II 0(0-4-2)

Prerequisite: EL 214 (or can be taken in the same semester as EL 214 or with the instructor's permission)

In this advanced course, students will be able to have classroom discussions and effectively communicate with English native speakers. Students will do communicative activities in class using English.

- Speaking: to practice academic speaking skills such as oral presentations and speeches.
- Writing: sentence and paragraph writing and summary writing.
- Listening : to study problematic sounds and become familiar with common listening problems.
- Reading: to study reading strategies; for example, speed reading, critical reading, reading extended texts and doing exercises.

Grading criteria: S (Satisfactory) or U (Unsatisfactory)

EL 314 Communicative English III 0(0-3-3)

Prerequisite : EL 215 (or can be taken in the same semester as EL 215 or with the instructor's permission.)

This course aims to prepare students for taking classes in English. Students will be assigned many activities such as oral reports and note-taking. They will practice their four skills through classroom activities. For example

- Speaking : oral presentations, seminars and group discussions
- Writing : academic reports and essays
- Listening : listening to lectures and practice in taking notes.
- Reading : reading extended academic texts and practicing summarizing.

Grading criteria *:* S (Satisfactory) or U (Unsatisfactory)

TH 160 Thai Usage 3(3-0-6)

Prerequisite: -

Study Thai language about alphabet, the sound system, the words and meaning, the structure of sentences. Also, the skills of listening, reading, and writing Thai. Emphasis is placed on encouraging effective communication skills.

TH 161 Thai Usage I 3(3-0-6)

Prerequisite: -

The aim of the theoretical part of the course is to lead into the more important sections, namely the practical ones, and these in turn are designed to promote skills in reading, listening, writing and speaking. All these skills will be achieved through emphasizing the depth of knowledge, ideas, reasoning and development of sound critical faculty. Students will be encouraged to read and criticize various types of writing from a broad perspective. The teaching method with regard to reading, listening, writing and speaking will be based on the principle of integration, with special emphasis on reading and writing.

TU 130 Integrated Sciences and Technology 3(3-0-6)

Prerequisite: -

A study of scientific concept, theory and rule concerning inorganic particle from the planetary level to particle level,

and to molecule and atom levels, the interaction between atom and molecule, chemical and inorganic chemical reaction relating to biological condition of living things and the evolution of life on the planet. The exploring of basic concepts in science and technology that are pertinent to modern day living, important debates concerning the relationship between science and technology and the environment and society and their distinctive features as separate fields of knowledge.

CN 208 Introductory Computer Programming 3(3-0-6)

Prerequisite: -

An introductory level to computer programming. Number systems. Introduction to computer organizations. Algorithms and flowcharts. Approaches for solving problems using a computer. Fundamental concepts of a programming language: data types, operators, variables, constants and expressions. Control structures: sequence, decision, repetition. Subprograms. Composite data structures.

MA 111 Fundamentals of Calculus 3(3-0-6)

Prerequisite: -

Review of the elementary number system and functions; Calculus of one variable functions; limit; continuity; the derivative and its applications; antiderivatives; techniques of integrations and its applications; series; Taylor's Theorem and its applications.

MA 112 Analytic Geometry and Applied Calculus 3(3-0-6)

Prerequisite: MA 111

Analytic geometry for Conic sections; second degree equations; vectors transformation of coordinates; polar coordinates and functions of Several variables; partial derivatives; multiple Integrals. scalar fields and vector fields; derivative of vector valued functions; Integration in the vector fields; Gauss's Theorem; Green's Theorem and Stoke's Theorem; Fourier and Laplace analysis and theirs applications.

MA 131 Applied Linear Algebra 3(3-0-6)

Prerequisite: -

Theorems of matrices; Hermitian matrices and unitrary matrices; LU-fractorizations; vector spaces; linear independence; dimensions; rank of matrices; applications of matrices for solving systems of linear equations; inverse of matrices; determinant; Cramer's Rule; Linear Transformations; inner product spaces; orthogonal complement and least square; eigenvalues; eigenvectors and its applications; diagonalizations of matrices; fundamentals concepts of tensor.

MA 214 Differential Equation 3(3-0-6)

Prerequisite: MA 112

First-order differential equations; second-order differential equations; homogeneous linear differential equations; nonhomogeneous linear differential equations; differential equations of higher order; series solution of linear differential equations; partial differential equations; the Laplace transform and Fourier transform; introduction to nonlinear differential equations; applications engineering problem solving.

SC 124 Chemistry for Engineers 3(3-0-6)

Prerequisite: -

Atomic Structure, Chemical Bonds, Gases, Solids, Liquid and Solutions, Chemical Equilibrium, Acids and Bases, Organic Chemistry, The Periodic Table, Transition Elements, Electrochemistry, Chemical Kinetics and Environmental Chemistry.

SC 133 Physics for Engineers I 3(3-0-6)

Prerequisite: -

Motion in one, two and three dimensions, motion and gravitation, work and energy, collides, rotational motion, equilibrium of rigid bodies, elasticity, fluids mechanics, harmonic oscillation, wave motions, sound and wave and applications, heat and kinetics theory, the 1st law and the 2nd of thermodynamics.

SC 134 Physics for Engineers II 3(3-0-6)

Prerequisite: Used to study SC 133

Electric charge and electric field, Gauss' law electric potential, capacitors and dielectrics, magnetic induction and Faraday's law of induction, inductor, AC circuits, electromagnetic theorem and application, optics (lens and optical equipment, reflection, refraction, interference, diffraction and polarization), modern physics.

SC 174 Chemistry for Engineers Laboratory 1(0-3-0)

Prerequisite: -

Practical work in support of SC 124

SC 183 Physics for Engineers Laboratory I 1(0-3-0)

Prerequisite: Used to study and study together with SC 133

Practical work in support of SC 133

SC 184 Physics for Engineers Laboratory II 1(0-3-0)

Prerequisite: Used to study and study together with SC 134

Practical work in support of SC 134

Compulsory Courses and Technical Electives

CE 100 Ethics for Engineers 0 (0-0-0)
(Participate activities organized by the faculty)

Prerequisite: -

Ethical issues relevant to the engineering profession. Potential impact of technology transfers and implementation with respect to society and its members. Potential problems that may arise are studied along with possible ways to prevent them from occurring and ways to deal with them once they occur.

CE 101 Introduction to Engineering Profession 2 (2-0-4)

Prerequisite: -

Engineering profession. Role and responsibility. Engineering fields. Curriculum and courses in engineering.

Problem solving in engineering. Mathematical and scientific tools. Tests and experiments. Engineers and society. Computers in engineering. Introduction to Standards and Safety. Units. Research methodology. Introduction to energy conservation and environment.

CE 202 Engineering Mechanics - Statics **3 (3-0-6)**

Prerequisite: SC 133

Equilibrium force analysis. Application of equilibrium equations for structures and machines. Center of gravity. Theorems of Pappus. Beams. Fluid mechanics. Friction. Analysis by inertia for mass. Introduction for bending moment, shear and deflection.

ME 111 Engineering Graphics **3 (2-3-4)**

Prerequisite: -

The significance of drawing. Instruments and their uses. Lining and lettering. Work preparation. Applied Geometry. Dimensioning and description. Orthographic projection. Pictorial drawing. Freehand sketching. Sectioning. Allowance and tolerance. Computer aided drawing for 2-D and 3-D objects.

IE 121 Engineering Materials I **3 (3-0-6)**

Prerequisite: -

Properties and structure of engineering materials such as metal, alloy, ceramics, plastics, rubber, wood and concrete. Phase diagram. Materials characteristics. Materials properties testing. Relation of microstructure and macrostructure with material properties. Manufacturing processes of materials. Effects of heat treatment on microstructure and properties of material.

IE 261 Engineering Statistics **3 (3-0-6)**

Prerequisite: -

Presenting and analyzing data. Probability theory. Statistics distribution. Sampling theory. Estimation theory. statistical inference. Hypothesis testing. Analysis of variance. Regression and correlation. Using statistical methods as the tool in engineering problem solving.

LE 200 Electromagnetic Theory **3 (3-0-6)**

Prerequisite: SC 134, MA 112

Vector analysis. Electrostatic fields. Conductors and dielectrics. Capacitance. Convection and conduction currents. Magnetic fields due to currents. Force and torque on a current loop in a magnetic field. Inductance. Electromagnetic induction. Displacement current. Maxwell's equations. Characteristics of electromagnetic wave. Electromagnetic waves in isotropic media. Wave polarization. Wave reflection and refraction. Introduction to transmission lines, antennas, and waveguides.

LE 201 Basic Electrical Engineering Design I **2 (1-3-2)**

Prerequisite: -

Laboratory to introduce students to basic equipment and measurements in electrical engineering. Students are required to complete design projects based on the material covered in Electric Circuits Analysis.

LE 202 Basic Electrical Engineering Design II **2 (1-3-2)**

Prerequisite: LE 201

Laboratory work and design projects on basic electronic circuits, digital systems, and electrical machines.

LE 210 Signals and Systems **3 (3-0-6)**

Prerequisite: -

Complex numbers and functions. Complex Integration. Representation and analysis of linear time-invariant systems for the continuous-time case. Convolution. Fourier series and transforms. Laplace transform. Introduction to random signals and systems. Controls and communications applications.

LE 220 Electric Circuit Analysis **3 (3-0-6)**

Prerequisite: SC 134

Circuit element, node and mesh analysis; Thevenin and Norton equivalent circuits; DC Transient and AC sinusoidal steady-state responses; phasor diagram; three-phase circuits.

LE 221 Basic Electronic Circuits & Devices **3 (3-0-6)**

Prerequisite: LE 220

Diode: physical structure, characteristics and modes of operation; diode application circuits; DC power supply amplifiers; BJT and FET physical structure, characteristics and modes of operation; use as an amplifier and a switch; biasing; principle of small-signal analysis; models for 2- and 3-terminal devices; operational amplifier and its applications in linear and nonlinear circuits; oscillator; power amplifiers; introduction to power electronics.

LE 230 Electrical Machines I **3 (3-0-6)**

Prerequisite: LE 220

Energy source, magnetic circuits, principles of electromagnetic and electrometrical energy conversion, energy and co-energy, construction of rotating machine, principle of *a.c.* and *d.c.* rotating machines and their efficiencies.

LE 301 Advanced Electrical Engineering Design I **2 (1-3-2)**

Prerequisite: LE 202

Laboratory work and design projects on topics in Electrical Engineering. Students are required to complete design projects.

LE 320 Digital Circuits Design **3 (3-0-6)**

Prerequisite: -

This course introduces the design and implementation of digital circuits. Topics include number representations, codes, Boolean algebra, logic gates, combinational and sequential circuits and design (both synchronous and asynchronous). The real implementations begin with basic gates and progress to Programmable Logic Devices (PLD).

LE 345 Microprocessor Systems Design 3 (3-0-6)

Prerequisite: LE 320

Introduction to microprocessors. CPU architecture. Instruction set. Assembly language programming techniques. Interrupts processing. CPU system architecture. Memory interface. Input/Output interface using parallel ports. Serial communications. A/D and D/A conversions. Introduction to microcontroller and microprocessor application.

COURSE DESCRIPTION AT NU

H62 SP1 Signal Processing 10 credits

Prerequisites: Working knowledge of Phasors applied to circuit analysis and Kirchoff's Laws. Complex Numbers, Integration. Basic ideas of frequency spectral representation of sinusoid and periodic signals.

Summary of Content: The aim of this module is to provide an introduction to signal processing methods. The module covers: Fourier series analysis of periodic signals; circuit analysis when input is periodic; introduction to Fourier transforms; circuit analysis when input is non-periodic; filter theory; passive and active analogue filters; discrete signals and the Sampling Theorem; discrete Fourier transforms; z-transforms and digital filters.

H52 FWA Fields Waves and Antennas 10 credits

Prerequisites: Background knowledge of electromagnetic fields. The ability to solve and understand second order differential equations.

Summary of Content: This module presents and develops the basic analytical, computational and experimental tools used in the study of electromagnetic fields and waves at high frequency. Topics covered include waves on transmission lines, Maxwell's equations and plane electromagnetic wave propagation, power flow, methods for electromagnetic field computation and an introduction to antennas and radar.

H52EA3 Group Design and Build Project 10 Credits

Prerequisites: H61DE1 Digital Electronics 1, H61SE1 Introduction to Software Engineering, H51EA2 Microprocessor Design Project

Summary of Content: This module takes the form of a laboratory-based project which is performed in groups of either 3 or 4 students. The overall aim of the project is to design, build, test and document a basic switched reluctance motor drive with microcomputer control. The project exercises and develops skills in analogue electronic design, digital electronic design, real-time software, presentation and group working.

H62CM1: Principles of Telecommunications 5 Credits

Prerequisites: Knowledge of Fourier analysis.

Description:

Introduction to analogue modulation and noise analysis in analogue systems

Topics include:

- amplitude modulation
- frequency modulation

- noise in analogue communication

H53PJ3 3rd Year Project **30 Credits**

Prerequisites: Successful completion of Part I of the degree course.

Summary of Content: Engineers working in industry usually find that they become involved in extended practical or theoretical projects. This module provides an opportunity for students to work in a similar situation. Students choose a project of interest to them, work under the supervision of a member of staff and write a dissertation on their work.

H53GP3 3rd Year Group Project **30 Credits**

Prerequisites: Successful completion of Part 1 of a degree course within the School of Electrical and Electronic Engineering.

Summary of Content: Students taking this module will work on a group project encompassing a broad range of engineering skills. The normal expectation is that project groups will have between four and eight students depending on the number in the cohort. Groups will work under the supervision of a member of staff.

G52CCN Computer Communications and Networks **10 credits**

Prerequisites: G51CUA Computer Use and Applications

Summary of Content: This module provides a basic introduction to computer communication networks. Itprovides an overview of underlying technologies including data transmission techniques, Local Area Networks, Wide Area Networks, internet working and network applications. Particular attention is paid to the Internet environment and the TCP/IP protocols.

H54ACD Advanced Control System Design **20 credits**

Prerequisites: An understanding of differential equations; matrices, determinants and matrix algebra; Laplace transfer functions.

Summary of Content: This module introduces the state-space representation of physical systems and the control design of multi-input multi-output systems using multi-variable control techniques. The module then covers both full and reduced observer design for those cases when state variables are not measurable. The module finishes with an overview of optimal control design.

H54CEM Control Electronics and Microprocessors **10 credits**

Prerequisites: Knowledge of basic digital electronics (such as that provided by H61DE1), knowledge of C programming (such as that provided by H61SE1), knowledge of drive systems (such as that provided by H5CEDR) and knowledge of digital control such as that provided by (H5CCT2).

Summary of Content: The course will cover the following aspects and will incorporate the most recent technical developments where appropriate:

- Analysis of typical input/output requirements for control of power electronic systems
- Review of standard microprocessor architectures
- Introduction to the features of microcontrollers and DSPs
- Interfacing and conditioning

- Principles of sampling and discretisation effects
- Practical control implementation.

H54IMD Induction Motor Drives **10 credits**

Prerequisites: Knowledge of basic control design methods (such as that provided by H52CT2) and knowledge of drive systems (such as that provided by H5CEDR).

Summary of Content: The course will cover the following aspects and will incorporate the most recent technical developments where appropriate:

- Review of open loop variable speed AC Drives and drive applications
- Space phasor and dq representation of induction machines
- Vector control techniques
- Self tuning techniques
- Sensorless vector drives
- Direct torque control.

H54PQE Power Quality and EMC **10 credits**

Prerequisites: Knowledge of power electronics principles and circuits (such as that provided by H5CPE2).

Summary of Content: The course will cover the following aspects and will incorporate the most recent technical developments where appropriate:

- Review of harmonics and Fourier series expansion
- Measures of power quality
- Supply harmonic performance of conventional rectifier circuits
- Single phase and 3 phase pulsed rectifier circuits
- Active power filters
- Introduction to EMC and its importance
- Principles of conducted emissions and their measurement
- Principles of radiated emissions and their measurement
- Mechanisms for emissions from power electronic equipment

- EMC countermeasures.

H54SPD Special Drives **10 credits**

Prerequisites: Knowledge of basic control design methods (such as that provided by H5CCT2) and knowledge of drive systems (such as that provided by H5CEDR).

Summary of Content: The course will cover the following aspects and will incorporate the most recent technical developments where appropriate:

- Review of DC Drives
- Introduction to permanent magnet machines
- Brushless DC machine drives
- Brushless AC machine drives
- Switched reluctance drives
- Synchronous machine drives.

H5BCT1 Control 1 **10 credits**

Prerequisites: Basic knowledge of engineering mathematical tools, including basic mechanics and linear differential equations.

Summary of Content: The aim of this module is to provide an introduction to the tools used for linear system control design. This module introduces:

- aims and principles of feedback control
- why feedback control is used
- block diagram representation of feedback systems
- quantification of control performance
- use of mathematical transfer function modelling of system elements
- relationship of system performance to characteristic equations.

The module includes many electronic and electrical examples, as well as a number of everyday examples of control systems.

H5BPE1 Power Electronics 1 **10 credits**

Prerequisites: Circuit theory and electronics at first year undergraduate level.

Summary of Content: This module is a general introduction to the subject of power electronics. The power electronics applications studied are those associated with electronic equipment and are relatively low current, to interest electronic as well

as electrical students. The subjects covered are:

- methods of analysis for power electronic circuits
- comparison of power supplies for electronic equipment
- switching regulators
- single phase rectifiers (controlled and uncontrolled)
- rectifier smoothing
- comparison of power device types
- calculation and management of losses in power devices
- practical considerations for high speed switching circuits.

H5CCT2 Control 2 **10 credits**

Prerequisites: Laplace transforms, modelling of linear physical systems, concepts of feedback, stability, characteristic equations and frequency response.

Summary of Content: This module enables students to design both analogue and digital controllers for linear single-input single-output systems. Students have access to CAD control design packages for evaluating control design. This module covers:

- design of analogue controllers using Root Locus Method
- closed loop performance and frequency response
- practical problems in digital control
- design of digital controllers using z-plane techniques
- practice with CAD package.

H5CEDR Electronic Drives **10 credits**

Prerequisites: or equivalent (basic ac and dc machines, power electronic converters, linear control design, power factor, harmonics and filters. H5CCT2 Control 2, H5CPE2 Power Electronics 2

Summary of Content: This module provides an understanding of how electrical machines and controlled power converters combine to form variable-speed drive systems meeting the need of motive power applications. This module includes:

- review of ac and dc machines
- brushless dc and switched reluctance machines
- power electronic control of machines

- control techniques and system performance
- drive comparison and applications
- performance, reliability and cost.

H5CEMA Electrical Machines **10 credits**

Prerequisites: Knowledge of electrical circuits, phasors, phasor diagrams, 3-phase systems, power transformers, magnetic fields, vector representation, calculus including partial differentiation.

Summary of Content: This module provides students with an understanding of the operational characteristics of common electrical machines (dc, ac induction, ac synchronous and stepping). Both theoretical and practical characteristics are covered. These include:

- principles and structure of dc machines - commutation effects
- principles and structure of induction machines
- ac synchronous and stepper motors
- parameterisation for performance prediction
- machine testing and evaluation
- saturation effects
- size, ratings and temperature limitations.

H5CPE2 Power Electronics 2 **10 credits**

Prerequisites: Understanding of transients in RL and RC networks, single-phase rectification, inductive and capacitive smoothing, diode and thyristor characteristics.

Summary of Content: This module provides students with an understanding of the operational principles of power electronic converters and their associated systems. This module covers:

- 3-phase naturally commutated ac-dc/dc-ac converters
- capacitive and inductive smoothing - device ratings
- dc-ac PWM inverters and modulation strategies
- resonant converters
- high power factor utility interface circuits
- thermal management of power devices including transient thermal effects.

H5CPNW Power Networks **10 credits**

Prerequisites: 3-phase ac electrical circuit analysis

Summary of Content: This module provides students with an understanding of power system apparatus and their behaviour under normal and fault conditions. It also provides an opportunity to apply CAD techniques to power system problems. This module covers:

- concept and analysis of load flow
- voltage/current symmetrical components
- computation of fault currents using z-bus method
- economic optimisation
- power-system control and stability
- Flexible AC Transmission (FACTS).

H62ANC Analogue Circuits **5 credits**

Prerequisites: A-level Physics or equivalent.

Summary of Content: This module considers a range of basic electronic circuits excluding broadband amplifiers but including:

- the voltage regulator and precision rectifier
- comparator and Schmitt trigger
- monostable and astable multivibrator
- other timing circuits
- resonance, tuned amplifier and oscillator
- active filters.

H62DE2 Digital Electronics 2 **10 credits**

Prerequisites: H61DE1 Digital Electronics 1

Summary of Content: More advanced techniques in digital electronic design will be introduced, the module will build on topics studied in H61 DE1 (Digital Electronics 1). The following topics will be covered:

- Quine-McCluskey minimisation
- iterative combinational design techniques

- use of PALs and PLAs in electronic design
- sequential design techniques using state tables and state diagrams
- the use of memory in computer systems and the applicability of different memory types (PROM, EPROM, EEPROM, DRAM, SRAM)
- the use of serial and parallel interfaces in computer systems
- the importance of component layout and decoupling in digital circuits
- introduction to VHDL.

A comparative study of microprocessors, microcontrollers and DSPs will also be undertaken so that the appropriate device may be selected in a practical situation. A laboratory-based introduction to digital CAD will form the practical side of the module.

H62OOP Object-oriented Programming **10 credits**

Target Students : Second year on Beng and Meng courses in School of Electrical & Electronic Engineering.

Prerequisites: Knowledge and practical experience of programming using the C programming language

Summary of Content: Object-oriented programming is now a firmly established methodology and is used in the C++ and Java languages. This module serves to introduce competent programmers in a procedural language (e.g. C) to object-orientated programming (OOP), using C++ as the vehicle. The three basic tenets of OOP (encapsulation, inheritance and polymorphism) will be considered in detail both from a conceptual viewpoint and in terms of the grammar and syntax necessary for programs in C++ to be written.

H62PEL Physical Electronics **10 credits**

Prerequisites: A-level Physics or equivalent.

Summary of Content: A simple account of energy states in atoms leads to a discussion of electrical conduction in metals. The ideas of electron mobility, Joule heating and temperature dependance of resistivity are introduced. Bonding in crystals is then covered, leading to a description of energy bands in semiconductor crystals. The flow of current in a semiconductor by both electrons and holes is described. An introduction to semiconductor statistics is then given, leading to a treatment of p-n junctions. Finally, the operation of the bipolar junction transistor is described.

H62SE2 C Programming for Engineers **5 credits**

Prerequisites: H6 1 SE1 [Introduction to Software Engineering] or similar.

Summary of Content: This module will introduce, and apply, relatively advanced C programming techniques to engineering problems. Topics that will be covered include:

- pointers

- dynamic memory allocation
- functions
- scope rules and the relationship between these topics.

The programs that will be written, as an integral part of the course, will be related to the areas of numerical modelling and signal processing.

H62TCS Telecommunications Systems **10 credits**

Prerequisites: Knowledge of basic signals (such as that provided by H61SIG)

Summary of Content: This module provides an introduction to telecommunication systems. Topics covered will include:

- modulation schemes (amplitude and frequency)
- delivery systems (copper, fibre, radio)
- regulation, licensing and spectrum managment
- propagation and interference
- network management issues
- image transmission (Fax, Slow scan TV, TV)
- Benefits of digital transmission (data compression).

H64CM3 Advanced Communications **20 credits**

Prerequisites: An understanding of AM and FM modulation techniques, intermediate level electronic circuits and basic electromagnetism. Summary of Content: This module covers the application and implementation of practical communications systems. Mobile and satellite communications and RADAR are presented as examples of modern systems. Consideration is given to the design and performance of the components and electronic circuits essential for the construction of these and related systems. The project work involves a literature search on a suitable topic and a design/simulation study of a practical aspect of a modern communication system.

H64HDL HDL for Reconfigurable Logic **20 credits**

Prerequisites: H61DE1 and H62DE2 or equivalent.

Summary of Content: This course will be divided into three: taught material, four hands on lab exercises and a hands-on project. TAUGHT MATERIAL This will contain the following: HDL Overview Hardware platforms i.e. FPGA architectures, migratiing to mask programmed ASICs, VHDL 1076 Syntax VHDL Case studies Mixed Analogue and Digital Hardware Description Languages Latest developments of HDL

LABORATORY EXERCISES Four separate lab classes will be carried out by the student. Here tasks, directly related to the on-going lecture material will be presented and implemented on a pre-prepared FPGA development board.

PROJECT Practical realisation of a digital system will be implemented on a pre-prepared FPGA development board. Marks will be awarded for: quality of code; functionality of the design; written report; plus other parameters to be specified during the course.

H64HSD High Speed Devices and Circuits **20 credits**

Prerequisites: Successful completion of the first and second years of a degree level course in Electrical and Electronic Engineering or Physics or an equivalent qualification.

Summary of Content: This module gives an overview of Semiconductor devices and circuits which have applications in High Speed Electronics and Telecommunications. In particular the module examines high speed MOS and MESFET's, HEMT's and HBT's. The design of high speed Analogue and Digital circuits will be discussed.

H64INM Instrumentation and Measurement **20 credits**

Prerequisites: Familiarity with Fourier transform techniques.

Summary of Content: This module is an introduction to the principles and practice of intrumentation and measurement systems. The module will cover the generally applicable basic principles and then look at the practical implementation through case studies of a small number of complete systems. Topics covered include:

- sensor types, operation and properties
- origins and characteristics of noise in measurement systems
- signal processing techniques for noise removal
- digitisation of data and computer interfacing
- data handling, storage and compression techniques
- case studies - optical measurement systems and motor systems

The coursework will be in the form of a design study or a data processing exercise.

H64SP2 Advanced Signal Processing **20 credits**

Prerequisites: Understanding of the mathematics of Fourier and Laplace transforms. Knowledge of basic analogue filter theory.

Summary of Content: This module provides the essential knowledge for the specification and design of signal processing systems. It will cover analogue and digital filter design, signal conditioning, sampling theory, convolution and correlation, bandwidth narrowing techniques, basic image processing, methods for spectral analysis and the performance and capabilities of commercially available DSPs.

H6CCM2 Digital Communications **10 credits**

Prerequisites: An understanding of Fourier series and transform techniques, including filtering, the convolution theorem and the sampling theorem.

Summary of Content: This module is an introduction to the operation of modern communication systems. In keeping with recent trends in communications, the module concentrates on digital communication systems. Topics covered include:

- communication systems
- information content and channel capacity
- digital modulation techniques
- data compression techniques
- error-correcting and line coding techniques
- digital signal regeneration techniques
- system examples, mobile telephones, satellite communications, FAX, Teletext, NICAM and CD technologies.

H6CCSA Computer System Architecture **10 credits**

Prerequisites: None.

Summary of Content: This module aims to introduce the principles of operation and organisation of the functional units of computer systems, and their interaction, as well as to discuss particular engineering solutions employed by present systems.

H6CEN1 Electronic Design **10 credits**

Prerequisites: H61ELN Electronic Circuits, H61ANE Analogue Electronics or equivalent.

Summary of Content: This module covers further topics relevant to the design of analogue circuits including:

- BJT small signal amplifiers
- MOSFET/JFET small signal amplifiers
- high frequency model and the Miller effect
- biasing using active loads
- cascode and differential pair, Mixers
- electrical noise.

H6CIND Industrial Awareness **10 credits**

Prerequisites: None.

Summary of Content: The module is taught by means of a number of workshops devoted to industrial case-studies, run jointly by

departmental staff and industrial colleagues. Coursework will be set following each workshop, activities will include information gathering, literature searches, strategy formulation and preparation of a summary report.

H6COPT Microwave and Optical Engineering **10 credits**

Prerequisites: H5 2 AEM [Applied Electromagnetism] or equivalent.

Summary of Content: This module will cover:

- review of electromagnetic spectrum and Maxwell's equations
- electromagnetic wave propagation; guided waves
- dispersion in propagating media and multimode fibres
- material and waveguide dispersion; indices
- analysis of rectangular waveguides
- discussion of circular optical fibre
- noise in detector systems
- basic operation of LEDs and laser diodes
- loss budgets in communication systems
- spatial frequency and spatial Fourier transform
- basic operation of a microscope and a CD player
- optical sensors.

H6CSE3 Object-oriented Programming **10 credits**

Target Students: Third year on Beng and Meng courses in Electrical & Electronic Engineering.

Prerequisites: Knowledge and practical experience of programming using the C programming language.

Summary of Content: Object-oriented programming is now a firmly established methodology and used in the C++ and Java languages. This module serves to introduce competent programmers in a procedural language (e.g. C) to object-oriented programming (OOP), using C++ as the vehicle. The three basic tenets of OOP (encapsulation, inheritance and polymorphism) will be considered in detail both from a conceptual viewpoint and in terms of the grammar and syntax necessary for programs in C++ to be written.

H6CSSD Solid State Devices **10 credits**

Prerequisites: An understanding of the physics of semiconductor materials. A good understanding of p-n junctions. Understanding of the nature of signals in information transfer. Basic understanding of the differential calculus and differential

equations.

Summary of Content: The aim of this module is to provide a detailed understanding of the internal operating mechanisms of selected electronic and opto-electronic devices such as light-emitting diodes, lasers, photodetectors and thin film transistors. Their operation will be described, and the characteristics required of these devices will be discussed in relation to their incorporation into appropriate electronic systems.

H6CTCE Telecommunication Electronics **10 credits**

Prerequisites: Successful completion of the First and Second Years of a degree course in Electrical and Electronic Engineering, or equivalent.

Summary of Content: This module covers the design and analysis of electronic systems used in telecommunications especially radio:

- oscillators
- amplifiers
- PLL
- mixers.

H6CVLS VLSI Design **10 credits**

Prerequisites: An understanding of digital electronics, electronic devices and circuits to second year degree level.

Summary of Content: This module provides an in-depth understanding of both full and semi custom CMOS integrated circuit design. It is biased towards electronic systems rather than solid state devices. The module covers:

- CMOS DC and Transient performance
- CMOS chip fabrication
- driving large capacitive loads
- layout limitations
- power dissipation - static and dynamic
- Combinational/Sequential/Peripheral circuit designs
- custom and semi-custom design styles
- scaling.