Computer Engineering Review

Overview

- CE Core Curriculum
  - Maths
  - Physics
  - Electrical Engineering
  - Comp Science
  - Computer Engineering
  - Management

Mathematics

- At present
  - Maths1A, 1B, Real and Complex Analysis, Probability and Statistics and Discrete mathematics
- Streamlined to
  - Maths 1A, 1B, IIA, and IIB (each of six credit points)
- Maths have agreed to the changes “in principle”
- All of the hard work was performed by the Maths experts in CSE and EE.

Physics

- Remains at two courses
  - Streamlined to be more relevant to the Computer Engineering Curriculum by having more Electromagnetism and Semiconductor Physics
  - Physics have agreed to this change

Electrical Engineering

- Presently
  - ELEC1011, Circuits and Systems I and II, Electronics, Telecommunications
- Future
  - Introduction to Electrical Circuits, Signals and Systems, Electronics and Telecommunications
- Agreed to by Electrical and Telecommunication Engineering

Computer Science

- Presently
  - COMP1A, COMP1B, COMP2011 and Software Engineering, Algorithms (0.5).
- Possible Scenarios
  - Keep it unchanged
  - COMP1B, COMP2011, Algorithms (1), and Software Engineering (new)
  - COMP1091, COMP2011, Algorithms (1) and Software Engineering (new)
  - COMP1091, COMP2091, Algorithms (1) and Software Engineering (new)

Computer Engineering

- At Present
  - COMP2021(DSS), Micros (COMP3221), Architecture(COMP3211), and OS.
- Future
  - Computer Engineering Fundamentals, Introduction to Digital Logic Circuits, Introduction to Microprocessors, Architecture, OS and Computer Engineering Project
  - Note that Digital Logic Circuits will no longer have assembler programming in the course.

Management, Ethics & Professional Issues

- At Present
  - COMP3710, 3720, and Ethics and Professional Issues
- Future
  - New COMP3710 and Ethics and Professional Issues

Program Structure
BE in Computer Engineering
Year 1

Session 1	**Session 2**
Maths 1A (6 UOC)	Maths 1B (6 UOC)
Physics 1A (6 UOC)	Physics 1B(6 UOC)
Computing 1X(6 UOC)	Computing 1Y(6 UOC)
Comp Eng Fundamentals (6 UOC)	Circuit Design and Analysis (6 UOC)

Year2

Session 1	**Session 2**
Maths 2A (6 UOC)	Maths 2B (6 UOC)
DSS (6 UOC)	Micros (6 UOC)
Computing 2X(6 UOC)	Software Engineering (6 UOC)
Circuits and Signals (6 UOC)	Electronics (6 UOC)

Year3

Session 1	**Session 2**
Computer Engineering Project (6 UOC)	Operating Systems (6 UOC)
Architecture (6 UOC)	Telecommunications (6 UOC)
GenEd 2X3UOC (6 UOC)	Elective N (6 UOC)
Elective (6 UOC)	Elective (6 UOC)

Year4

Session 1	**Session 2**
Thesis A (6 UOC)	Thesis B (6 UOC)
Management + E & P (6 UOC)	Thesis B (6 UOC)
GenEd 2X3UOC (6 UOC)	Elective (6 UOC)
Elective (6 UOC)	Elective (6 UOC)

Program Structure

YEAR 1		UOC S1	UOC S2
COMP1011 COMP1711	Computing 1A or Higher Computing 1A	6	-
COMP1021 COMP1721	Computing 1B or Higher Computing 1B	-	6
ELEC1011	Electrical Engineering 1	-	6
MATH1141 MATH1131	Higher Mathematics 1A or Mathematics 1A	6	-
MATH1241 MATH1231	Higher Mathematics 1B or Mathematics 1B	-	6
MATH1081	Discrete Mathematics	6	-
PHYS1131	Higher Physics 1A	6	-
PHYS1231	Higher Physics 1B	-	6
		24	**24**

YEAR 2		UOC S1	UOC S2
ACCT9003	Accounting Fundamentals	3	-
COMP2011 COMP2711	Data Organisation or Higher Data Organisation	6	-
COMP2021	Digital Systems Structures	6	-
COMP3111	Software Engineering	-	6
COMP3221	Microprocessors & Embedded Systems	-	6
ELEC2031	Circuits and Systems A	3	-
ELEC2032	Circuits and Systems B	-	3
MATH2610 MATH2510	Higher Real Analysis* or Real Analysis	3	-
MATH2620 MATH2520	Higher Complex Analysis* or Complex Analysis	-	3
MATH2859	Probability, Statistics and Information	3	-
	General Education	-	6
		24	**24**

YEAR 3		UOC S1	UOC S2
COMP3710	Software Project Management	-	3
COMP3211	Computer Architecture	-	6
COMP3231	Operating Systems	6	-
ELEC3006	Electronics A	6	-
MATH2509 COMP3120	Linear Algebra or Introduction to Algorithms	-	3
TELE3013	Telecommunications Systems 1	-	6
	Computer Engineering Electives	6	6
	General Education	6	-
		24	**24**

YEAR 4		UOC S1	UOC S2
COMP3720	Total Quality Management	3	-
COMP4910	Thesis Part A	3	-
COMP4911	Thesis Part B	-	15
COMP4920	Professional Issues and Ethics	-	3
	Computer Engineering Electives	18	6
		24	**24**

COMP1XX1

Pre-requisites:
Co-requisites:
Exclusions:

Session offered:

UOC:

Course Information:
This is the first course in Computer Engineering. It gives an overview on the profession and practice of computer engineering. It provides an introduction to basic technical skills including techniques to analyse simple circuits, hands-on experience on building and testing circuits, and professional skills. It is a pre-requisite for the subsequent course on Circuit Design and Analysis. The co-requisites are Maths 1-A and Phys 1-A.

Course Objectives:
At the end of the course students should:
a. Be clear on what is electrical/electronic engineering, what these engineers do, and realise that this is an extremely interesting and challenging profession.
b. Make progress in the development of skills in technical writing, critical and analytical thinking, team work, and problem solving.
c. Understand the elementary concepts of electrical circuits and their analysis.
d. Become familiar with basic laboratory equipment and techniques to measure electrical quantities.

Learning Outcomes:
On successful completion the student should be able to:
1. Use standard laboratory equipment such as oscilloscope, power supply, signal generators, multimeters for measurement and testing.
2. Construct (inc. soldering) and test simple circuits that contain resistors, capacitors, diodes and transistors.
3. Demonstrate familiarity with basic circuit components and their electrical characteristics, analyse simple DC circuits with series/parallel combinations of resistors.
4. Communicate effectively through written technical reports and oral presentations.

Teaching Methods:
Lectures: 2 *hrs/week* Tutorials: 2 *hrs/week* Labs: 2 *hrs/week*

Syllabus:
Part 1: Introduction to circuit elements and analysis (first 7 weeks)

- Circuit concept: model, circuit element, node, mesh, loop, branch, interconnection.
- Units and scales.
- Electric charge, voltage, current, power, energy, the passive convention.
- Resistors, Ohm’s Law.
- Ideal voltage source.
- Kirchhoff’s Laws (KVL and KCL).
- Analysis of resistive circuits from first principles.
- Simplification of resistive circuits, series, parallel equivalents.
- DC and sinusoids.
- Introduction to diodes and transistors.
- Two-level (analogue) signals using transistor as a switch.
- Elementary digital circuit elements (from transistors to logic gates).
- Truth table, Boolean expression.

- Combinational circuits using logic gates.

Part 2: Introduction to the engineering profession (last 7 weeks)

- The engineering profession: what is computer engineering, engineering systems, roles and obligations of engineers to society, perspectives from currently practicing professional engineers from industry.
- Overview of major computer engineering disciplines: Computer Design and Architecture, Computer Systems, Communications, and latest research directions.
- Basic professional skills: information gathering (library skills, the Internet), technical communication (oral and written skills), teamwork, problem solving.
- Engineering ethics: referencing, plagiarism, copyright issues, academic misconduct.

Laboratory Program:

- Electrical safety, grounding.
- Construction of prototype boards. Building simple circuits. Soldering.
- Laboratory instruments: signal generator, oscilloscopes, power supply, multi-meter.
- Voltage, current and resistance measurements. Short-circuit risk.
- Series and parallel resistor combinations, voltage divider, current divider. Power
- dissipation in a resistor (heat and power ratings).
- Measuring the properties of diodes and transistors.
- Build simple logic gates (NOT, NAND) from BJTs in saturation.

Contribution to Graduate Attributes:

a. Development of in-depth knowledge and understanding in the discipline.
b. Development of analytical and critical thinking (via laboratory work and creative problem solving).
c. Development of effective communication (via formal written reports and oral presentation).
d. Team and collaborative working skills (via group project work and interactive learning).
e. Development of information literacy skills, researching information sources (via use of library, Internet).

Recommended Text(s):

R.C. Dorf and J.A. Svoboda, Introduction to Electric Circuits, 6th Ed., Wiley, 2004.
R.H. Katz, Contemporary Logic Design, Addison Wesley, 1993.
Carr, Elements of Electronic Instrumentation and Measurement.
C.H. Sides, How to Write and Present Technical Information, 3rd Ed., Cambridge, 1999.

Further Text(s) and Reference(s):

Lecture Notes on laboratory safety.

Assessment Methods:

The assessment scheme in this course reflects the intention to split marks evenly between performance in the final examination and learning progress through the session. Ongoing assessment through the session occurs through the quizzes, the labs, and the project.

Assessment Weighting:

- **Final Examination** (55 %): The examination format will be similar to the previous years' examinations. However, the emphasis on the various sections of the course may vary from previous years. The final examination is of three hour duration, covering all aspects of the course that have been presented in lectures, tutorials, labs and quizzes.
- **Quizzes** (15 %): There will be a total of three quizzes, testing understanding of the principles and analytical skills.
- **Assessment** (15%): The experiments are divided into 7 modules to be completed within the first 7 weeks. The demonstrators will be assessing work during the lab period. Marks will be allocated based on understanding of the lab and on fully completing the experiments. A satisfactory performance (50% or greater) in the

laboratory component is a necessary requirement to pass this course, irrespective ofmarks in the other components. Also, students are required to attend all scheduled laboratory sessions.
Project (15 %): Project

PROPOSAL TO INTRODUCE A NEW COURSE
(formerly known as subject)

1. COURSE DETAILS

1.1 Course ID COMP4021(?) (where to get the ID for new course?)

1.2 Course name – Long

Embedded System Design: Team Projects

1.3 Course name - Abbreviated

Embedded System Design

1.4 Course Authority

Dr. H.A. Guo **ext/email** 57136/huig@cse.unsw.edu.au
A/Prof. Sri Parameswaren **ext/email** 57223/sridevan@cse.unsw.edu.au

1.5 Organisational Unit responsible for course

School: Computer Science and Engineering

Faculty: Engineering

Academic Group Code (Faculty): ENG

Academic Organisation Code (Owner): COMPSC

1.6 Justification of Proposal

The course is proposed to enhance the computer-engineering program. The current engineering courses provided in the school mainly focuses on the fundamentals of computer systems at different levels, either in hardware or software. Embedded system design provides an inter-disciplinary area that integrates both hardware and software designs. With the fast growing embedded system market, it is of high career and employment advantage for our computer engineering students if they have gained some experience, knowledge and skills in embedded system design.

The course will cover the overview of embedded system design cycle, hardware/software co-design strategies and teamwork practice.

1.7 Consultation Process

The proposal was based on the comprehensive survey on many other prestigious universities in Australia and overseas.

1.8 Units of credit (UOC) Session/s offered Hours Per Week

6 UoC Available S1 and S2 5 hours per week

1.9 Pre-requisites: COMP3221, or (COMP2021 and (COMP3211 or 32331))
Co-requisites:
Exclusions: COMP9??? (the same course ID for postgraduate students)

1.10 Proposed Entry in the Faculty Handbook

UC 6 HPW5 Prerequisites: COMP3221 Embedded System Design Team Projects. Embedded system design life cycle. Software/hardware codesign. Hardware selection process. Software development techniques. Hardware/software integration and system testing. Project report writing.

1.11 Is this course replacing an existing course?

NO

1.12 Undergraduate / Postgraduate

1.13 Elective

1.14 Program stage

Stage 1. First offered in S1, 2005 S1 if possible; otherwise in S2, 2005.

1.15 Program/s in which course is be available

BE 3648, MEngSc 8685, ME 2665, MSc 2765, PhD 1650

1.16 Proposed teaching methods and assessment practices

Examinable, with design deliverables, demonstration and written report

1.17 Assessment grades to be used

Full range of grades (HD, DN, CR, PS, FL)

1.18 Mode of delivery

Internal

1.18.1 Multi-mode Delivery Guidelines

The following issues should be addressed in proposals for Multi-mode delivery:
Not Applicable

1.19 Information Technology Requirements for students

Standard resources available in the school plus the electronic and other components required, with budget of $200 for a project team.

1.20 Textbooks

No specific textbook except lecture notes.

Recommended references:

1. Arnold Berger, Embedded System Design: An Introduction to Processors, Tools, and Techniques, CMP Books, 2002
2. Horowitz and Hill, The Art of Electronics, 2nd ed. Cambridge University Press, 1999.
3. Fredrick M. Cady: Microcontrollers and Microcomputers —Principles of Software and Hardware Engineering.

4. Jonathan W. Valvano, Introduction to Embedded Microcomputer Systems, 2003.
5. M. Markel, *Writing in the Technical Fields,* IEEE Press, 1994

1.21 Industrial experience component
(where applicable)

2. RESOURCE STATEMENT

2.1 Enrolments
Estimated or proposed enrolments for the next three years.

2005: 20

2006: 40

2007: 80

2.2 Resource Requirements

Staffing Requirements:

Hours per week

Full-time Academic Staff: 6 hours/week (3 hours for lecturer, 2 hours for lab supervisor)

Part-time Teaching Staff: 3 hours/week

General Staff: Covered by standard support of the Computer Support Group

Field Costs:

Studio/Laboratory Requirements:

Microprocessor projects Lab, PCB prototyping facility

Materials Requirements:

microprocessor chips, basic electronic components and PCB boards

Equipment Costs:

$200 per team

Computing Requirements:

The studio for microprocessor programming, Protel for PCB board.

Library Requirements:

Standard textbook/reference requirements for a course of this size

Capital Funds Requirements:

$250 * 4?

2.3 Servicing Implications:

Course proposals which involve servicing arrangements with Schools/Departments across Faculty boundaries should be considered by the other relevant Faculties or Boards of Studies.

Will service teaching be provided, or has it been in the past and will no longer be provided by another department/school? Provide details of any discussions/agreements reached, particularly with regard to resource re-allocation.

2.4 Teaching Arrangements:

(i) Will other units contribute on a regular basis to the teaching of this course?

NO

(ii) If so, which units are involved and what proportion of the course will they teach?

2.5 Alternative Delivery Arrangements:

Provide details of the alternative delivery arrangements eg. distance delivery modules, short-term residential school etc including the method of preparing teaching materials and their delivery. The Resource Authorisation from the University Librarian (section 3.1) should reflect the consultation undertaken with regard to any special services that will need to be provided for students.

2.6 Details of Tuition Fees:

Proposed fee: standard for an Engineering course of this type

3. AUTHORISATION

3.1 University Librarian's Endorsement

Note: *this section of the Proposal must be signed by a Library representative, stating:*

I have examined the Library needs related to the above proposal and certify that existing Library holdings, staffing, services and accommodation are adequate / inadequate (delete one) to cover the demands that are inherent in it.

Appropriate arrangements for the use of digitised material to support this course have been made by the Course Authority with the University Librarian.

Further Comments:

University Librarian
/ /2004

3.2 Head of School's Approval

Note: *this section of the Proposal must be signed by the Head of School, stating:*

I have examined the resource implications of the above proposal in regard to staff, space, materials, equipment, capital funds, and computing, and certify that the School can cover the demands that are inherent in it.

Further Comments:

Head of School
/ /2004

3.3 Dean's Approval

Note: *this section of the Proposal must be signed by the Dean, stating:*

I have examined the resource implications of the above proposal in regard to staff, space, materials, equipment, capital funds, and computing, and certify that:

(Tick whichever is applicable)

3.3.1 (i) the proposal involves no additional resources. (A statement from the Head of School explaining how this can be achieved must be provided); or

(ii) the proposal involves additional resources and it is proposed to redeploy existing resources within the faculty. (A statement from the Head of School explaining how this will be achieved must be provided); or

(iii) the proposal involves additional resources to be obtained as set out below; or

(iv) the additional resources essential to bring the proposal into effect cannot be found within resources available to the faculty.

3.3.2 **Fees** (delete if not applicable):

- a fee will not be charged for this program (other than HECS)
- a fee will be charged for this program for local fee-paying students
- a fee will be charged for international students

If a fee is to be charged the Dean certifies as follows:

I have ensured that the Vice-Chancellor has been advised of the proposed fee arrangements, and note that approval of fee arrangements is needed before the new program can be implemented.

3.3.3 the proposal conforms to the University's commitment to Equal Opportunity in Education.

Statement from Head of School on Source of Additional Resources and/or Further Comments:

Dean
/ /2004

Please click on link for
HDISABILITY GUIDELINES FOR ACADEMIC STAFF PREPARING COURSESH

PHYS1XX1 Higher Physics 1A

Course Information:

This course was developed by the School of Physics to provide an in-depth introduction to the core areas of basic physics, primarily for first year Electrical Engineering and Telecommunications, Computer Engineering and Advanced Science students. The course provides an introduction to Mechanics, Electricity and Magnetism. (Higher Physics 1A is a companion course to PHYS1231 Higher Physics 1B which covers the topics Waves, Sound, Light, Thermal Physics, Quantum, Solid State and Semiconductor Physics.) The treatment of topics includes methods of calculus and high school extension mathematics throughout, and assumes a minimum of HSC Physics or equivalent.

Course Objectives:

At the end of the course students should:

- Have gained a broad conceptual and mathematical understanding of physical systems and phenomena in all of the core areas.
- Have experience and skills in the mathematical modelling and quantitative formulation of physical problems.
- Have gained practical laboratory experience in the measurement of physical systems, a familiarity with laboratory measurement techniques and an understanding of approximating, estimating and limits and confidence levels in experimental work.
- Be familiar with the application of fundamental physical principles to selected real world systems and the connection between fundamental physics principles and engineering applications.

Learning Outcomes:

On successful completion the student should be able to:

- Apply fundamental laws and mathematical techniques to solve a wide range of problems in basic physics. In certain classes of problems students should be able to improvise new solutions by drawing on techniques from different areas and broader mathematical knowledge.
- Conceive, plan and carry out original experimental investigations (research projects) in basic physics.
- Plan and execute experimental work and prepare written reports on practical investigations in any of the syllabus topic areas.
- Demonstrate the ability to analyse operation and behaviour of real-world physical systems and phenomena in terms of basic physical laws and mathematical description.

Teaching Methods:

Lectures: 3 *hrs/week* Tutorials: 1 *hrs/week* Labs: 2 *hrs/week*

Syllabus:

Vectors. Particle kinematics in 1, 2 and 3 dimensions. Equations of motion in vector form. Newton's laws, particle dynamics, applications. Circular motion. Hooke's law. Work and energy, conservation of energy, conservative forces, applications. Frictional forces. Momentum, many particle systems, centre of mass. Collisions in 1 and 2 dimensions. Rotational kinematics and dynamics, inertia, torque, rotational dynamics, conservation. Kepler's laws. Gravitation, applications in solar system and astronomy.

Electrostatics, Coulomb's law, electric field, permittivity, charge distributions. Gauss' law and vector fields. Electrical potential energy and potential, point charges and charge distributions. Equipotentials. Capacitance and dielectrics. Magnetism, magnetic materials, B and H, permeability. Current carrying wires loops, solenoids, toroids. Dipoles. Magnetization. Ampere's law, applications. Biot-Savart law, applications. Force on moving charges, Hall effect. Faraday's law and motional emf, Lenz's law. Generators. Inductance, inductors, energy storage.

Laboratory Program:

Introductory Experimentation: error analysis, graphical representation; Further Experimentation: error estimation, analysis and processing, optimisation of measurements and experimental technique; Equilibrium of Rigid Bodies; Collisions and Car Crashing; Capacitors; Direct Current Circuits: sources of emf; Electrostatic Field plotting; Magnetic Fields and Slinky Coil; Resonance in a.c. Electrical Networks.

Contribution to Graduate Attributes:

- Development of numeracy, quantitative estimation and mathematical modelling skills
- Ability to understand and apply complex conceptual, technical and mathematical information across broad areas of a mathematically-based discipline
- Team and collaborative working skills
- An appreciation and respect for diversity
- Planning, negotiation skills, delegation and reporting within a technical context
- Researching information sources, discriminating source quality and acknowledgement

Recommended Text(s):

- Physics: Calculus, Second Edition, Eugene Hecht, ISBN: 0-534-36270-2

Further Text(s) and Reference(s):

- Experimental Methods, L. Kirkup, Pub. Wiley; this book may be helpful for the lab work but is not essential.
- Physics for Scientists and Engineers, Paul A. Tipler, 4th Ed. or later, ISBN: 1-57259-673-2.
- Fundamentals of Physics, 6th Ed. or later, D. Halliday, R. Resnick and J. Walker, Pub. Wiley.

Assessment Methods:

Assessment is based on performance in two examinations, plus Laboratory/Workshop physics, and four quizzes.

Assessment Weighting:

- **Final Examination** (30 %): 3 hour exam containing Papers 2 and 1R. Paper 2 covers the second 7 weeks of syllabus topics. Paper 1R is a repeat test allowing students to be re-examined on the first 7 weeks of syllabus topics to achieve a better performance if desired. Paper 2 is compulsory; Paper 1R is optional. Students can choose to attempt Paper 1R on the basis of their Paper 1 performance and on personal study planning. There is no requirement for students to register for Paper 1R.

- **Quizzes** (20 %): Four quizzes (weighting 5% each) are available in Weeks 3, 6, 9 and 12. The quizzes are administered within WebCT. Immediate on-line feedback is provided.

- **Laboratory Assessment** (20%): Each Laboratory or Workshop is graded; the grading is based on compulsory pre-work (completed prior to the class) and performance in the lab. There are 10 labs/workshops in total per Session.

- **Mid-Session Examination** (30% %): Mid-Session Examination

PHYS1XX2 Higher Physics 1B

Course Information:

This course was developed by the School of Physics to provide an in-depth introduction to the core areas of basic physics, primarily for first year Electrical Engineering and Telecommunications, Computer Engineering and Advanced Science students. The course provides an introduction to the topics Waves, Sound, Light, Thermal Physics, Quantum, Solid State and Semiconductor Physics. (Higher Physics 1B is a companion course to PHYS1131 Higher Physics 1A which covers the topics Mechanics, Electricity and Magnetism.) The treatment of topics includes methods of calculus and high school extension mathematics throughout and assumes a minimum of HSC Physics or equivalent.

Course Objectives:

At the end of the course students should:

- Have gained a broad conceptual and mathematical understanding of physical systems and phenomena in all of the core areas.
- Have experience and skills in the mathematical modelling and quantitative formulation of physical problems.
- Have gained practical laboratory experience in the measurement of physical systems, a familiarity with laboratory measurement techniques and an understanding of approximating, estimating and limits and confidence levels in experimental work.
- Be familiar with the application of fundamental physical principles to selected real world systems and the connection between fundamental physics principles and engineering applications.

Learning Outcomes:

On successful completion the student should be able to:

- Apply fundamental laws and mathematical techniques to solve a wide range of problems in basic physics. In certain classes of problems students should be able to improvise new solutions by drawing on techniques from different areas and broader mathematical knowledge.
- Conceive, plan and carry out original experimental investigations (research projects) in basic physics.
- Plan and execute experimental work and prepare written reports on practical investigations in any of the syllabus topic areas.
- Demonstrate the ability to analyse operation and behaviour of real-world physical systems and phenomena in terms of basic physical laws and mathematical description.

Teaching Methods:

Syllabus:

Oscillating systems. SHM and applications, damped SHM and resonance. Mechanical travelling waves, wave speed, energy, wave power and intensity. Superposition, interference, standing waves and resonance. Waves in elastic media, sound waves, sources of sound, beats, Doppler effect. Light, E-M spectrum, coherence, interference and thin films, diffraction, gratings and spectra. Two slit and circular aperture, interference and diffraction combined. Linear and circular polarisation.

Temperature and heat. Temperature measurement. Kinetic theory and ideal gases. Specific heat and heat capacity of ideal gases and solids. First law of thermodynamics, applications. Heat transfer.

The Bohr atom. de Broglie's hypothesis. Schrödinger equation, wave function, hydrogen atom, quantum numbers, spin. Wave packets. Uncertainty Principle. Free electron model. Quantum statistics, quantized free electron model, Fermi level. Energy bands, band gaps; metals semiconductors, insulators. Bonding, crystal lattices. Drude model. Carrier concentration, Hall effect. Intrinsic and extrinsic semiconductors, effects of temperature. Band structure of Si and GaAs, direct vs indirect band gap, electron velocity, momentum, effective mass, electrons and holes. PN junction inc i-v characteristic. BJT. MOSFET. Absorption of light by semiconductors, photoconductivity. LEDs and the semiconductor laser.

Laboratory Program:

Interference in thin films. Linear oscillatory motion. Specific heat and cooling. Standing waves in an air column. Standing waves on a wire.

Contribution to Graduate Attributes:

- Development of numeracy, quantitative estimation and mathematical modelling skills
- Ability to understand and apply complex conceptual, technical and mathematical information across broad areas of a mathematically-based discipline
- Team and collaborative working skills
- An appreciation and respect for diversity
- Planning, negotiation skills, delegation and reporting within a technical context
- Researching information sources, discriminating source quality and acknowledgement

Recommended Text(s):

- Physics: Calculus, Second Edition, Eugene Hecht, ISBN: 0-534-36270-2

Further Text(s) and Reference(s):

- Experimental Methods, L. Kirkup, Pub. Wiley; this book may be helpful for the lab work but is not essential.
- Physics for Scientists and Engineers, Paul A. Tipler, 4th Ed. or later, ISBN: 1-57259-673-2.
- Fundamentals of Physics, 6th Ed. or later, D. Halliday, R. Resnick and J. Walker, Pub. Wiley.

Assessment Methods:

Assessment is based on performance in two examinations, carrying equal weight, plus Laboratory/ Workshop/Project physics and four quizzes distributed throughout the Session.

Assessment Weighting:

- **Final Examination** (30 %): 3-hour examination containing Papers 2 and 1R. Paper 2 covers the second 7 weeks of syllabus topics; Paper 1R is an optional repeat test allowing students to be re-examined on the first 7 weeks of syllabus (as per PHYS1131).

- **Quizzes** (20 %): Four quizzes (weighting 5% each) are conducted in Weeks 3, 6, 9 and 12. The quizzes are administered within WebCT, on-line feedback is provided.

- **Laboratory Assessment** (10%): Each Laboratory or Workshop is graded; the grading is based on compulsory pre-work (completed prior to the class) and performance in the lab. There are 10 labs/workshops in total per Session.

- **Mid-Session Examination** (25 %): Mid-Session Examination

- **Project** (15 %): Project

1 Page Review of Proposed Maths Subject

Maths 1-A

- Complex numbers (properties, exponentials & trig., polynomials, circuit theory examples)
- Vectors over the reals
- Matrix algebra (Gaussian elimination, determinants, transpose)
- Vector geometry (lengths, dot product, cross product, projection, equations of lines, planes)

- Functions and graphs (high school review)
- Limits and continuity
- Differentiability
- Properties of differentiable functions (extrema, mean-value-theorem, l'hopital's rule, etc.)
- Inverse functions (inc. injective, surjective, bijective)
- Parametric and polar representations
- Logs and exponentials
- Functions of several variables
- Integration
- Integration techniques & applications

Maths 1-B

- Number theory (primes, divisibility, GCD, Euclid's algorithm, modular arithmetic)
- Logical reasoning and methods of proof (converses, counter-examples, contradiction, induction, constructive)
- Set theory
- Sequences and cardinality (countability)

- Vector spaces
- Linear transformations
- Eigenvalues and eigenvectors
- Solution to ordinary differential equations
- Sequences and series

Maths 2-A

- Vectors, curves and vector functions (inc. differentiation and integration of vector funcs)
- Partial derivatives, gradients, normals, etc.
- Taylor series
- Critical points
- Jacobian + change of integration coordinates
- Line integrals
- Divergence, curl and Green's theorem

- Limits, continuity and differentiability of complex functions (Cauchy-Riemann eqns)
- Analytic and harmonic functions (harmonic conjugates and analytic continuation)
- Exponentials, trig and hyperbolics
- Logs and trig inverses
- Contour integrals & Cauchy's formula
- Laurent series, singularities & residues

Maths 2-B

- Probability theory (events, independence, conditional probability, Bayes formula)
- Random variables and vectors (marginal and conditional distributions, expectation, covariance and correlation)
- Standard distributions (Bernoulli, Binomial, Poisson, Uniform, Normal)
- Central limit theorem

- Vector spaces
- Linear transformations and change of basis
- Inner products
- Orthogonalization
- Least squares approximation and regression
- QR factorization
- Determinants
- Eigenvalues, eigenvectors & diagonalization
- Singular value decomposition
- Matrix exponentials and systems of DE's

ELEC1XX2 Circuit Design and Analysis

Co-requisites:

MathsEE1B

Course Information:

This course provides the basic skills in the analysis and design of electrical and electronic circuits. The course draws on content from MathsEE1A, PhysEE1A and EEY1S1.

Course Objectives:

At the end of the course students should:

a. Be able to design simple electrical/electronic circuits.
b. Be able to analyse circuits under DC or AC mode of operation.
c. Possess elementary appreciation of the transient effects.
d. Understand elementary combinational and sequential logic at a hands-on level.
e. Make progress in the development of skills in technical writing, critical and analytical thinking, teamwork, and problem solving.

Learning Outcomes:

On successful completion the student should be able to:

1. Design, construct and test a variety of simple circuits using passive components as well as diodes, transistors, op-amps, and logic gates.
2. Simplify a series/parallel combination of impedances; apply node/mesh analysis and other techniques such as superposition, Thévenin/Norton transformation.
3. Determine the transient response of first-order RL and RC circuits.
4. Use computer programs to simulate and analyse simple circuits.
5. Communicate effectively through written technical reports and oral presentations.

Teaching Methods:

Lectures: 2 *hrs/week* Tutorials: 2 *hrs/week* Labs: 2 *hrs/week*

Syllabus:

- Ideal current source.
- Controlled (dependent) sources.
- Node analysis, super-nodes.
- Loops, meshes, mesh analysis, super-meshes.
- Linearity, superposition, Thévenin and Norton equivalents.
- Non-ideal voltage and current sources, 1-ports.
- Energy dissipation, power, maximum power transfer.
- Energy storage: capacitors and inductors.
- RC and RL circuits: step, exponential, sinusoidal inputs.
- Impedance, admittance, reactance, conductance, susceptance.
- Series and parallel combinations of impedances.
- Introduction to transformers, mutual inductance.
- Power sources: power supplies, batteries, solar cells.
- Transistor models and circuits (common emitter, emitter follower, etc)
- Non-linear resistors, load lines.
- Diode models and circuits (rectifiers, voltage clippers, etc), Zener diodes.
- Ideal op-amp, simple op-amp circuits.
- Sinusoidal signal: frequency, angular frequency, peak value, rms value, and phase. DC vs AC, average vs RMS values.
- AC circuits (RC, RL) with sinusoidal inputs in steady state and transient.
- Latches. Simple sequential logic.
- Introduction to computer-aided design and analysis (SPICE, MATLAB).

Laboratory Program:

- Revise electrical safety.
- Power supply. Voltage divider. Current divider. Thévenin. Norton.
- RC and RL circuits. Step response. Frequency response.
- Build and test simple transistor circuits (resistors + BJTs).
- Build and test simple op-amp circuits (resistors + op-amps).
- Build and test a simple power supply (transformer + diodes + capacitor).
- Experiment with discrete logic gates and latches.
- Build and test sinusoidal oscillator based on BJT and positive feedback through RC networks.

Contribution to Graduate Attributes:

a. Development of in-depth knowledge and understanding in the discipline.
b. Development of analytical and critical thinking (via laboratory work and creative problem solving).
c. Development of effective communication (via formal written reports and oral presentation).
d. Team and collaborative working skills (via group project work and interactive learning).
e. Development of information literacy skills, researching information sources (via use of library, Internet).
f. Development of in-depth knowledge and understanding in the discipline.
g. Development of analytical and critical thinking (via laboratory work and creative problem solving).
h. Development of effective communication (via formal written reports and oral presentation).
i. Team and collaborative working skills (via group project work and interactive learning).
j. Development of information literacy skills, researching information sources (via use of library, Internet).

Recommended Text(s):

- R.C. Dorf and J.A. Svoboda, Introduction to Electric Circuits, 6th Ed., Wiley, 2004.
- A.S. Sedra and K.C. Smith, Microelectronic Circuits, 4th Ed., Oxford, 1998.
- Carr, Elements of Electronic Instrumentation and Measurement.
- C.H. Sides, How to Write and Present Technical Information, 3rd Ed., Cambridge, 1999.

Further Text(s) and Reference(s):

- Lecture Notes on laboratory safety.
- D.M. Etter, Engineering Problem Solving with MATLAB, Prenctice Hall, 1997.
- R.W. Goody, MicroSim PSPICE for Windows – Volume 1, Prentice Hall, 1998.

Assessment Methods:

The assessment scheme in this course reflects the intention to split marks evenly between performance in the final examination and learning progress through the session. Ongoing assessment through the session occurs through the quizzes, the labs, and the project.

Assessment Weighting:

- **Final Examination** (55 %): The final examination is of three hours duration, covering all aspects of the course that have been presented in lectures, tutorials, labs and quizzes.
- **Quizzes** (15 %): There will be a total of three quizzes, testing understanding of principles and analytical skills.

- **Laboratory Assessment** (15%): The experiments are divided into 7 modules to be completed within the first 8 weeks. Demonstrators will assess work during the lab period. Students will be allocated marks based on understanding of the lab and on fully completing the experiments. A satisfactory performance (50% or greater) in the laboratory component is a necessary requirement to pass this course, irrespective of marks in the other components. Also, students are required to attend all scheduled laboratory sessions

- **Project** (15 %): Project

ELEC2XX5 Analogue Electronics

Pre-requisites:

ELEC2XX2 Circuits and Signals.

Course Information:

The course is offered as a core course for computer, telecommunications, and electrical engineering students. It provides the minimum required skills in analogue electronics design required for computer and telecommunications engineers while providing electrical enginnering students with core knowledge and design skills on which other courses build; the course is the prime prerequisite for ELEC3XX2, Electronics Circuit Design.

Course Objectives:

At the end of the course students should:

a. have core skills in fundamental analogue electronic circuit analysis and design, such that they can design all or most key analogue components in a typical system powered from a mains power outlet and interfacing to a digital sub-system.

Learning Outcomes:

On successful completion the student should be able to:

1. demonstrate an understanding of common semiconductor device physics and models (diodes and transistors);
2. analyse electronic circuits with non-linear and reactive devices;
3. use common semiconductor devices in the design of amplifiers, power supplies and non-linear circuits;
4. demonstrate an understanding of and apply feed-back in circuit design;
5. demonstrate an understanding of A/D and D/A converter principles; and
6. analyse heat flow and design heat sinks for power devices.

Teaching Methods:

Lectures: 3 *hrs/week* Tutorials: 1 *hrs/week* Labs: 2 *hrs/week*

Syllabus:

Device physics of diodes, BJTs and MOSFETs. Nonlinear transistor models: Ebers-Moll, transport. Full and simplified models of BJTs and MOSFETs (inc. small-signal models). Zener and Schottky diodes.
DC biasing, biasing using current sources, operating point, large-signal analysis. Linearisation, small-signal analysis.
Input- and output impedances, power gain. Two-ports. Feed-back, effects of feed-back; stability and compensation techniques.
Circuits with non-ideal op-amps. Common base, emitter and collector amplifiers; differential pairs. Multistage amplifiers, cascades, cascodes. AC response of 1-stage amplifiers, Miller effect. Output stages, thermal considerations, heat sinks.
Non-linear circuits: oscillator, Schmitt trigger. A-D and D-A converter principles. Introduction to power supply design: linear and switched-mode; battery charger.

Laboratory Program:

Simulations using SPICE vs. measurements and hand calculations.
Common emitter, common collector, common base and differential amplifier design.
Power amplifiers + heat sinks.
Feed-back, effects of feedback.
Power supply design.
Amplifier frequency response.
Practical aspects in designing electronic circuits (effects of stray capacitance, noise coupling, grounding techniques, power supply decoupling).

Contribution to Graduate Attributes:

a. the capacity for analytical and critical thinking and for creative problem solving;
b. information literacy — the skills to appropriately locate, evaluate and use relevant information.
c. The skills required for collaborative and multidisciplinary work.

Recommended Text(s):

- Sedra and Smith, Microelectronic Circuits, Oxford.
- Lecture notes on non-linear circuits and practical electronics design.

Further Text(s) and Reference(s):

- P. Horowitz and W. Hill, The Art of Electronics, Cambridge: CUP, 1989 (2nd edn).

Assessment Methods:

All parts of the assessment will be marked according to the amount of work done, the correctness of the work, and the displayed knowledge and understanding of the topic.

Assessment Weighting:

- **Final Examination** (55 %): The final examination is a three hour closed book written examination covering all aspects of the course that have been presented in lectures, tutorials, and labs.
- **Laboratory Assessment** (15%): There will be a total of six laboratory experiments. Students will have to prepare in advance for each laboratory unit and the laboratory demonstrators will assess the preparation as well as the progress and compleation of each laboratory unit. Students will recieve marks for each unit.
- **Assignment** (15 %):
- **Group Project** (15 %): Students will do projects in groups of two or three where projects the students will design and build an electronic sensor or like device which can interface to a microprocessor. The project is a part of an overall project structure together with projects in ELEC2XX4 Embedded Systems Design and ELEC2XX1 Digital Circuit Design.

ELEC2XX2 Circuits and Signals

Course Information:

This course encourages a continuing exploration of electronic circuit design and analysis. It provides an introduction to concepts of signals and signal processing, and to how circuits and signals are related. It is a prerequisite for the core course and all professional electives offered in the signal processing area, as well as those courses involving more advanced electronic circuit design. In undertaking this course, knowledge and experience is drawn from first year electronic circuit courses and first year courses in mathematics.

Course Objectives:

At the end of the course students should:

a. Further enhance students understanding of simple as well as more complex circuits and circuit elements.
b. Introduce students to signals, teaching them how they are represented, and to be familiar with the different types of signals.
c. Help students understand the importance of signals as basic elements of systems, with reference to electronic circuits.
d. Familiarise students with the time and frequency domain analysis of continuous-time signals, and circuits up to second order.
e. Give students an understanding of basic transform techniques for continuous-time signals.
f. Introduce students to discrete-time signals, and their representation in difference equations.
g. Provide opportunities for students to gain practical experience in the use of computer design and analysis tools such as Matlab and PSPICE.

Learning Outcomes:

On successful completion the student should be able to:

1. Demonstrate the ability to analyse simple to moderately complex electronic circuits up to second order using a variety of methods, and have an intuition as to which methods are preferable for different circuits.
2. Demonstrate intuition of the effects different types of signals have on systems, in particular the electronic circuits under study.
3. Demonstrate understanding of discrete-time concepts including discrete-time signals and their difference/relationship to continuous-time signals, and solving simple linear discrete-time difference equations.

Teaching Methods:

Lectures: 3 *hrs/week* Tutorials: 1 *hrs/week* Labs: 2 *hrs/week*

Syllabus:

Circuit elements - energy storage and dynamics. Transient response of circuits. Impulse and step responses. First and second order systems and circuits; RLC circuits. State space representation of systems and circuits. Bode plots. Phasors. Signal representation. Continuous and discrete-time signals. Solutions to differential equations. Periodic and aperiodic signals. Signals as an integral part of circuits and systems. Time-invariance, causality and linearity. Convolution. Laplace transforms of signals and circuits. Transfer functions. Fourier transforms. Continuous Fourier series. Difference equations and their solution. Frequency response. Basic sampling theory and ideal A/D conversion (teaser).

Laboratory Program:

- >Simulations using SPICE, MATLAB and C.
- Build, test and analyse second-order linear circuits, RL + RLC.
- Analogue frequency response. Step response. Bode plots.
- Sampling, experiments with A/D and D/A converters.
- DSP boards + C programming to do digital filter and difference equation experiments.

Contribution to Graduate Attributes:

a. Analytical skills, critical thinking and creative problem solving will be developed by the laboratory experiments and interactive checkpoint assessments during the labs.
b. Self-assessment of independent and reflective learning is made available through a series of quizzes which span the duration of the course, together with the online learning material.
c. Demonstration of the understanding of principles, and the effective use and communication of relevant information will be tested in depth in the final examination.

Recommended Text(s):

- R.C. Dorf and J.A. Svoboda, Introduction to Electric Circuits, 6th Ed., Wiley, 2004.
- Oppenheim and Willsky, Signals and Systems, 2nd Ed., Prentice Hall, 1997.
- Etter, D.M., Engineering Problem Solving with MATLAB, Prentice Hall, 1997.
- Goody, R. W., MicroSim PSPICE for Windows - Volume 1, prentice Hall, 1998.

Further Text(s) and Reference(s):

- Herniter, M. E., Schematic Capture with MicroSim PSPICE, 3rd Ed., Prentice Hall, 1998.

Assessment Methods:

The assessment scheme in this course reflects the intention to split marks evenly between performance in the final examination and learning progress through the session. Ongoing assessment through the session occurs through quizzes and the laboratory program.

Assessment Weighting:

- **Final Examination** (50 %): The final examination is of 3 hour duration, and will cover all material that has been presented in the lectures, tutorials, labs, and quizzes. The examination will assess knowledge and understanding of all major aspects covered in the course. As such it will comprise four (4) or five (5) questions of similar or slightly varying weight, perhaps with an extra optional question included for choice. One past exam paper is made available for information.
- **Quizzes** (25 %): There will be a total of six (6) quizzes, testing understanding of principles, analytical skills and basic competence in the laboratory, in the following format:
  Quiz 1 to 5: to be done before or at the beginning of the lab sessions using WebCT/paper. Short duration: 5 x 3 marks.
  Quiz 6: to be done during a lecture in week 13. Longer duration: 10 marks.
- **Laboratory Assessment** (25%): All laboratory experiments, of which there are five (5) or six (6), are constructed to address the different major aspects of the course. During each lab experiment, lab demonstrators will assess work and will allocate marks based on understanding of the lab and on fully completing the experiments. A laboratory exam will be held toward the end of the course (weeks 13 - 14) with emphasis placed on understanding and basic competence in the lab. The duration of the lab exam will be approximately one (1) hour.
  Lab Exam: 15 marks
  Lab Experiments: 10 marks

Computer engineering curriculum in the new millennium
McGettrick, A.; Theys, M.D.; Soldan, D.L.; Srimani, P.K.; Education, IEEE Transactions on , Volume: 46 , Issue: 4 , Nov. 2003 Pages:456 - 462

Developing an integrated computer engineering technology curriculum
Bari, J.; Frontiers in Education, 2002. FIE 2002. 32nd Annual , Volume: 3 , 6-9 Nov. 2002 Pages:S2A-1 - S2A-3 vol.3

Stuffing more learning into the computer engineering curriculum bag: capstone course preparation
Conrad, J.M.; Frontiers in Education, 2002. FIE 2002. 32nd Annual , Volume: 2 , 2002 Pages:F3D-20 - F3D-23 vol.2

Reengineering the curriculum: design and analysis of a new undergraduate Electrical and Computer Engineering degree at Carnegie Mellon University
Director, S.W.; Khosla, P.K.; Rohrer, R.A.; Rutenbar, R.A.; Proceedings of the IEEE , Volume: 83 , Issue: 9 , Sept. 1995 Pages:1246 - 1269

Computer engineering at the University of Illinois at Urbana-Champaign
Loui, M.C.; Education, IEEE Transactions on , Volume: 37 , Issue: 3 , Aug. 1994 Pages:322 - 327

The new electrical and computer engineering curricula at University of California-Davis
Soderstrand, M.A.; Education, IEEE Transactions on , Volume: 37 , Issue: 2 , May 1994 Pages:136 - 146

Integrating computer engineering education with a platform for learning
Heer, D.; Traylor, R.; Thompson, T.; Fiez, T.; Frontiers in Education, 2003. FIE 2003. 33rd Annual , Volume: 2 , 5-8 Nov. 2003 Pages:F2F - 17-22 Vol.2

ECE 21: a new curriculum in electrical and computer engineering
Scoles, K.; Bilgutay, N.; Frontiers in Education Conference, 1999. FIE '99. 29th Annual , Volume: 2 , 10-13 Nov. 1999 Pages:12B5/10 - 12B5/14 vol.2

A forward-looking electronics and computer engineering technology program
Nowlin, R.W.; Sundararajan, R.; Education, IEEE Transactions on , Volume: 42 , Issue: 2 , May 1999 Pages:118 - 123

University of Toronto curricula in electrical and computer engineering
Smith, H.W.; Education, IEEE Transactions on , Volume: 37 , Issue: 2 , May 1994 Pages:158 - 162

Computer engineering technology-a new option
Schultz, T.W.; Frontiers in Education Conference, 2000. FIE 2000. 30th Annual , Volume: 1 , 18-21 Oct. 2000 Pages:T4E/7 - T4E/9 vol.1

Panel on computing curricula: computer engineering
*Srimani, P.K.; Soldan, D.L.; Impagliazo, J.; Hughes, J.; Nelson, V.P.;*Frontiers in Education, 2002. FIE 2002. 32nd Annual , Volume: 2 , 2002 Pages:F4G-1 vol.2

New computer engineering and microelectronics curriculum development for system-on-chip era
Tenhunen, H.; Isoaho, J.; Frontiers in Education Conference, 1999. FIE '99. 29th Annual , Volume: 1 , 10-13 Nov. 1999 Pages:11A3/24 - 11A3/29 vol.1