EEECS
MODULE
DESCRIPTIONS

2024-2025

STAGE 1

CSC 1024 - Programming and Systems Development
Course Detail
Career: Undergraduate
Units: 40.00
Grading Basis: Graded
Course Components: Lecture Required, Practical Required
Assessment: Individual Contribution 35%, Practical Exam 10%, Project 35%, Class Test 20%
Pre-Requisites: None
Co-Requisites: None
Compulsory Element: Students must complete all elements of module assessment and attain an overall pass.
Course Contents
This module will introduce the fundamentals of programming. You will explore real-world problems through worked programming examples which will encompass learning good algorithm design. This will be achieved using appropriate programming constructs such as assignment, selection and repetition. You will also be introduced to simple data structures and object-oriented programming.
Supplementary Notes: None
Learning Outcomes: Students must be able to:

- Demonstrate knowledge, understanding and the application of the principles of procedural programming, including:
  - Primitive data types
  - Simple abstract data structures, i.e. strings and arrays
  - Sequencing, selection and iteration
  - Functions/methods and composition
  - Input/output and error handling
- Demonstrate knowledge and understanding of the principles of object-oriented programming, including:
  - Classes, objects and inheritance
- Analyse real-world business challenges in combination with programming concepts and data manipulation to write code in an effective way to solve the problem.
- Fully test a system by applying user acceptance testing
- Demonstrate knowledge, understanding and the application of the software systems design with a focus on users and key stakeholders, including
  - Classification of user/system requirements in line with the problem domain
- Demonstrate knowledge, understanding and the application of working as part of a team to deliver a solution to a client

Skills:
KNOWLEDGE & UNDERSTANDING: Understand fundamental theories of procedural programming
INTELLECTUAL AND PRACTICAL:

- Be able to design and develop small programs, which meet simple functional requirements expressed in English.
- Programs designed, developed and tested will contain a combination of some or all of the features as within the Knowledge and Understanding learning outcomes.

CSC 1025 – Procedural Programming [MATHS & CS]
Course Detail
Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Component: Lecture Required, Practical Required
Assessment: Continual Assessment 100%
Pre-Requisites: None

Co-Requisites: None
Compulsory Element: Students must complete all elements of module assessment and attain an overall pass.
Course Contents
This module introduces the fundamentals of procedural programming. Using a problem-solving approach, real-world examples are explored to promote code literacy and good algorithm design. Students are introduced to the representation and management of primitive data, structures for program control and refinement techniques, which guide the development process from problem specification to code solution.
Supplementary Notes: None
Learning Outcomes: Students must be able to:

- Demonstrate knowledge, understanding and the application of the principles of procedural programming, including:
  - Primitive data types (including storage requirements)
  - Program control structures: Sequencing, selection and iteration
  - Functions/methods and data scope
  - Simple abstract data structures, i.e. strings and arrays
  - File I/O and error handling
  - Pseudocode and algorithm definition/refinement
- Apply good programming standards in compliance with the relevant codes of practice e.g. naming conventions, comments and indentation
- Analyse real-world challenges in combination with programming concepts to write code in an effective way to solve the problem.

Skills:
KNOWLEDGE & UNDERSTANDING: Understand fundamental theories of procedural programming

INTELLECTUAL AND PRACTICAL:

- Be able to design and develop small programs, which meet simple functional requirements expressed in English.
- Programs designed, developed and tested will contain a combination of some or all of the features as within the Knowledge and Understanding learning outcomes.

CSC 1026 - Fundamentals of Maths for Computing

Course Detail
Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Component: Lecture Required, Practical Required
Assessment: Continual Assessment 60%, Timed exam on Computer 40%
Pre-Requisites: None
Co-Requisites: None
Compulsory Element: Students must complete all elements of module assessment and attain an overall pass.
Course Contents
This module will introduce the fundamentals of maths for students studying a computing degree. As you progress through your nominated degree you will need to understand the concepts of algorithms design, logical reasoning and programming. Therefore, it is necessary to understand how to apply mathematical arguments and knowledge to model real world problems. This module will also cover key mathematical concepts for problem solving and analysis including: number theory, algebra, logic, set theory, vectors and matrices, statistics and graph theory. This will allow you to apply mathematical reasoning about problems and programs and strategies for problem solving.
Supplementary Notes: None
Learning Outcomes: Students must be able to:

- Demonstrate knowledge, understanding and the application of the principles of number theory to include:

    - Number systems, arithmetic operations, prime numbers, fundamental theorem of arithmetic.
- Demonstrate knowledge, understanding and the application of the principles of algebra to include:
    - Algebraic expressions and notation for the product and summation of algebraic terms.
- Demonstrate knowledge, understanding and the application of the principles of logic to include:
    - Propositional logic, predicate logic and proofs.
- Demonstrate knowledge, understanding and the application of the principles of set theory to include:
    - Sets, set operations, set equality, subsets, sequences and functions.
- Demonstrate knowledge, understanding and the application of the principles of vectors & matrices to include:
    - Addition, multiplication, distributive and associativity, and identity matrix.
- Demonstrate knowledge, understanding and the application of the principles of statistics to include:
    - Probability theory and introductory methods for data analysis.
- Demonstrate knowledge, understanding and the application of the principles of graph theory to include:
    - Graph models, trees, paths, cycles, Euler's theorem.

Skills: None

CSC 1027 – Programming

Course Detail

Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Components: Lecture Required, Practical Required
Assessment: Class Test 20%, Continual Assessment 50%, Timed exam on Computer 30%
Pre-Requisites: None
Co-Requisites: None
Compulsory Element: Students must complete all elements of module assessment and attain an overall pass.

Course Contents

This module introduces the fundamentals of object-oriented programming. Real-world problems and exemplar code solutions are examined to encourage effective data modelling, code reuse and good algorithm design. Fundamental OO programming concepts including abstraction, encapsulation, inheritance and polymorphism are practically reviewed through case studies, with an emphasis on testing and the use of code repositories for better management of code version control.

Supplementary Notes: None
Learning Outcomes: Students must be able to:

- Demonstrate knowledge, understanding and the application of the principles and application of object-oriented design, to include:
    - Abstraction, encapsulation, inheritance and polymorphism
- Demonstrate knowledge of static data modelling techniques (through UML)
- Demonstrate knowledge, understanding and the application of the principles and application of object extensibility and object reuse.
- Demonstrate knowledge, understanding and the application of more advanced programming concepts, to include:
    - Recursion
    - Searching and sorting
    - Basic data structures
- Demonstrate knowledge, understanding and the application of testing, in particular, unit and integration testing.
- Apply good programming standards in compliance with the relevant codes of practice and versioning tools being employed e.g. naming conventions, comments and indentation

- Analyse real-world challenges in combination with OO programming concepts to write code in an effective way to solve the problem.

Skills:
KNOWLEDGE & UNDERSTANDING: Understand fundamental theories of object-oriented programming
INTELLECTUAL AND PRACTICAL:

- Be able to design, develop and test programs, which meet functional requirements expressed in English.
- Programs designed, developed and tested will contain a combination of some or all of the features as within the Knowledge and Understanding learning outcomes.

CSC 1029 - Object Oriented Programming

Course Detail
Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Components: Lecture Required, Practical Required
Assessment: Class Test 20%, Continual Assessment 50%, Timed exam on Computer 30%
Pre-Requisites: None
Co-Requisites: None
Compulsory Element: Students must complete all elements of module assessment and attain an overall pass.
Course Contents
This module introduces the fundamentals of object-oriented programming. Real-world problems and exemplar code solutions are examined to encourage effective data modelling, code reuse and good algorithm design. Fundamental OO programming concepts including abstraction, encapsulation, inheritance and polymorphism are practically reviewed through case studies, with an emphasis on testing and the use of code repositories for better management of code version control.
Supplementary Notes: None
Learning Outcomes: Students must be able to:

- Demonstrate knowledge, understanding and the application of the principles and application of object-oriented design, to include:
  - Abstraction, encapsulation, inheritance and polymorphism
- Demonstrate knowledge of static data modelling techniques (through UML)
- Demonstrate knowledge, understanding and the application of the principles and application of object extensibility and object reuse.
- Demonstrate knowledge, understanding and the application of more advanced programming concepts, to include:
  - Recursion
  - Searching and sorting
  - Basic data structures
- Demonstrate knowledge, understanding and the application of testing, in particular, unit and integration testing.
- Apply good programming standards in compliance with the relevant codes of practice and versioning tools being employed e.g. naming conventions, comments and indentation
- Analyse real-world challenges in combination with OO programming concepts to write code in an effective way to solve the problem.

Skills:
KNOWLEDGE & UNDERSTANDING: Understand fundamental theories of object-oriented programming
INTELLECTUAL AND PRACTICAL:

- Be able to design, develop and test programs, which meet functional requirements expressed in English.
- Programs designed, developed and tested will contain a combination of some or all of the features as within the Knowledge and Understanding learning outcomes.

CSC 1032 – Introduction To Cyber Security

Course Detail
Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Components: Lecture Required, Practical Required
Assessment: Continual Assessment 100%
Pre-Requisites: None
Co-Requisites: None
Compulsory Element: None
Course Contents

- Introduction and Cybersecurity concepts
- Access control and authentication
- Risk Assessment/Management
- Social Engineering
- Basic Crypto Systems
- Weaknesses of cryptosystems
- Cryptosystems in GSM technology

Supplementary Notes: None
Learning Outcomes:

- Understand the core principles of secure information system design.
- Identify and analyse the current threats and challenges to the security of information systems, data and services.
- Evaluate system protection technologies and methods.
- Apply knowledge of cryptographic algorithms to provide data confidentiality.

Skills:
Improving Own Learning and Performance, Problem Solving, planning and researching assignments, design and implementation of solutions

CSC 1033 – Introduction To Computer Architecture

Course Detail
Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Components: Lecture Required, Practical Required
Assessment: Continual Assessment 100%
Pre-Requisites: None
Co-Requisites: None
Compulsory Element: None
Course Contents

- Computer Abstractions and Technology
- Basic computer organisation
- Digital Design Basics
- Number Representation
- Arithmetic for Computers
- Microarchitecture Basics – Pipelining
- Instructions: Language of the CPU
- Instruction Set Architectures
- Basic Assembly Programming
- Compilation Flow (how high-level languages are operated)

- The role of the operating system

Supplementary Notes: None

Learning Outcomes:

- Describe how information (e.g. numbers, characters etc.) is represented in computers.
- Describe the internal hardware organisations that form a computer.
- Describe how a high level program is executed in a computer, including the role of the operating system
- Implement basic assembly language programs
- Describe some of the fundamental differences between instruction set architectures

Skills:

Application of Number, ICT, Improving Own Learning and Performance, Problem Solving, Design and Implementation of solutions, Programming

CSC 1034 – Data Driven Systems

Course Detail

Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Components: Lecture Required, Practical Required
Assessment Coursework: Class Test 40%, Project 60%
Assessment: Exam Session
Pre-Requisites: None
Co-Requisites: None
Compulsory Element: None

Course Contents

This module introduces essential concepts and skills for developing data-driven web applications, covering relational and NoSQL databases, and client-side technologies (HTML, CSS, JAVAScript). Emphasizing best practice software design principles, development activities are underpinned by industry standard approaches to software modelling, designing methodologies, software testing principles and key security considerations. Additionally, this module fosters transversal skills such as communication, teamwork, problem-solving and agility in a team environment. Aimed at providing a strong technical and theoretical foundation, this module equips students for the dynamic field of web development and software design, blending technical competencies with essential soft skills for the software industry.

Supplementary Notes

None

Learning Outcomes

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

- Design and implement relational and NoSQL databases, understanding their respective use-cases and benefits,
- Develop interactive web pages using HTML, CSS and JavaScript, adhering to modern web standards .
- Employ fundamental software design and testing principles in the development process, integrating modelling techniques, design methodologies, and ensuring code reliability and functionality.
- Understand and apply fundamental principles of security in web development and database management, recognising common vulnerabilities and learning to implement basic protective measures.

- Apply and evaluate the transversal skills associated with software development including effective communication, teamwork, problem-solving, and adaptability in a team environment.

Skills

- Design and implementation of modern data driven systems considering technical and environmental aspects.

CSC1035 - Introduction to Embedded Systems

Course Detail
Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Components: Lecture Required, Practical Required
Assessment Coursework: 100%
Pre-Requisites: None
Co-Requisites: None
Compulsory Element: None

Course Contents

This module introduces the concepts and techniques involved in developing embedded systems including small-board computers and IoT devices. It will include an introduction to microcontroller electronics and printed circuit boards as well as an introduction to the programming of embedded systems.

Supplementary Notes

None

Learning Outcomes

On successful completion of the course the student will:

- understand the basis structure of a computer program suitable for deployment in an embedded system.
- understand the basic structure of an MCU (Microcontroller Unit).
- understand how to develop software for the MCU.
- understand how basic analogue and digital interface circuits are designed for an MCU.
- understand how to develop event-driven ISR (Interrupt Service Routines).
- understand in general how Printed Circuit Boards (PCBs) are designed and constructed.

Skills

The skills developed by the students during this course are as follows:

- How to use an IDE (Integrated Development Environment) for developing embedded software programs.
- Understand how to edit, compile and test/debug simple embedded programs.
- Design simple programming routines to carry out real-world tasks.
- Understand how to design simple embedded systems to solve real-world problems.

ECS 1001 - Embedded Systems

Course Detail
Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Components: Lecture Required
Assessment: Laboratory Coursework 100%
Pre-Requisites: None.
Co-Requisites: None.
Compulsory Element: None
Course Contents

1. Introduction to Computer Programming using Python
2. Introduction to Embedded Systems Programming using Arduino C
3. Introduction to Microcontroller Electronics
4. Introduction to Printed Circuit Board Design

Supplementary Notes: None.
Learning Outcomes
On successful completion of the course the student will:

- Understand the basic structure of a computer program, using both Python and the C programming languages.
- Understand the basic structure of an MCU (Microcontroller Unit)
- Understand how to develop software for an MCU.
- Understand how basic analogue and digital interface circuits are designed for an MCU.
- Understand how to develop event-driven ISR (Interrupt Service Routines).
- Understand how Printed Circuit Boards (PCBs) are designed and constructed.

Skills
The skills developed by the students during this course are as follows:

- How to use an IDE (Integrated Development Environment) for developing simple software programs.
- Understand how to edit, compile and test/debug simple programs.
- Design simple programming routines to carry out real-world tasks.
- Understand how to design simple embedded systems to solve real-world problems.
- Use a PCB design tool to design a basic Printed Circuit Board (PCB).

ECS 1005 – Digital Systems

Course Detail
Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Components: Lecture Required, Practical Required, Tutorial Required
Assessment: Class Test 40%, Coursework 40%, Coursework 20%
Pre-Requisites: None
Co-Requisites: None
Compulsory Element: HDL coursework
Course Contents:
The course develops the basics of logic components and digital circuits, and how they are implemented in real digital hardware platforms. The learning outcomes will address the following topics about the creation of digital systems:

- Number systems (Binary, Octal, Hexadecimal)
- Basic Gates in digital systems
- Combinational logic design
- Karnaugh maps (k-maps)
- Digital circuit minimisation via Boolean Algebra
- Digital circuit minimisation via Quine-McCluskey
- Sequential logic design

- Flip-flops
- Timing considerations
- Digital hardware technologies
- Multiple outputs and ROMs
- Field Programmable Gate Array (FPGA) technology
- Digital Counters
- Finite State Machines
- Computer architecture fundamentals
- Instruction Set Architecture (ISA)
- Verilog Hardware description Language (HDL)

Supplementary Notes: None

Learning Outcomes

The module will provide a sound understanding of digital system design illustrated through practical digital hardware circuit design and programming skills using Verilog HDL programming. After the completion of this module you will be able to:

- Design, implement and analyse the operation of both combinational and sequential logic circuit based on a system specification
- Understand the concept of cost in digital technologies and techniques to learn techniques to minimize the cost
- Understanding architecture systems architecture and design
- Program and design a digital design on Field Programmable Gate Array (FPGA) technology

Skills

During this course of this module you will acquire the following key skills:

- How to model, analyse, optimize and implement digital systems
- Fundamentals of computer architecture
- Problem solving Programming a real Field Programmable Gate Array (FPGA) system
- ICT skills
- HDL programming skills

ECS 1006 – Fundamentals of Electric Circuits

Course Detail

Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Components: Lecture Required, Practical Required, Tutorial Required
Assessment: Class Test 5%, Coursework 10%, Examination 60%, Practical 15%, Project 10%
Pre-Requisites: None
Co-Requisites: None
Compulsory Element: Laboratories
Course Contents:

Lectures:

1. Introduction to Fundamental Components (R, L, C)
2. Circuit Elements and Sources
3. Electric Circuit Laws and Theorems
4. AC and DC Circuit Analysis
5. Phasor Representation
6. Frequency Response of Simple Circuits
7. Basic amplifiers and system concepts
8. Feedback systems and operational amplifiers (Op Amp)
9. Diode characteristics and circuits – analysis and applications
10. Bipolar junction transistor (BJT)

Design project:

- Design of a DC Power Supply

Supplementary Notes: None

Learning Outcomes

On completion of this module, a student will have achieved the following learning outcomes commensurate with module classification:

- Understand fundamentals of electric circuits, AC/DC circuit theorems, analysis techniques
- Understand phasor representation of alternating voltages and currents
- Acquire a practical understanding of the course material through a range of lab experiments
- Understand analogue electronic devices and analogue circuits
- Develop an understanding of the experimental design and analysis of electrical power supplies, design and test methodologies
- Demonstrate analysis and interpretation of circuit results
- Develop a fundamental understanding of electronics principles needed for analogue circuit design
- Develop a practical understanding of the different roles of electronic devices in simple analogue and digital electronic circuits and systems.

Skills

Skills developed by students during this module are as follows:

General:

- Analysis of simple DC and AC electric circuits

Laboratory & Design Project:

- Development and analysis of a simple DC power supply circuit
- Measurement of key characteristics of electrical and electronic systems
- Debugging of electronic systems
- Testing of electronic systems
- Use of laboratory instruments
- Use of electrical/electronic engineering principles to develop solutions
- Presentation of technical engineering information clearly and concisely in written form
- Analysis of simple analogue circuits
- Use of electrical/electronic engineering principles to develop circuit solutions

ELE 1012 - Mathematics 1

Course Detail

Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Components: Lecture Required, Tutorial Required
Assessment: Continual Assessment 50%, Paper 50%
Pre-Requisites: None.
Co-Requisites: None.
Compulsory Element: None
Course Contents:

Complex Arithmetic:

1. Complex numbers: fundamentals, modulus and argument, Argand diagrams.
2. Complex forms: cartesian, exponential, conversions between forms, conjugation
3. Arithmetic: addition/subtraction, multiplication, division, exponentiation
4. DeMoivre's theorem

Linear Algebra:

1. Vector arithmetic: concept, high-dimensional objects and arithmetic operations.
2. Matrices: fundamentals, notation, determinants, transposition
3. Matrix arithmetic: addition/subtraction, multiplication, division, inversion, triangularisation.
4. Linear equations: solution by Gaussian Elimination, Cramer's Rule, Matrix Inversion.

Differentiation:

- Fundamentals; Curve Sketching; Product and Chain Rules; Parametric Differentiation; Logarithmic Differentiation; Partial Differentiation

Differential Equations:

- Fundamentals; 1st Order Methods; 2nd Order Methods

Integration:

- Fundamentals; Integrating functions of functions; Integration functions of linear functions; Integration by parts; Integration by substitution; Integration by Reduction Formula; Applications

Sequences and Series:

Fundamentals; Convergence and Limits; Tests of Convergence; Power Series Properties; Limits for Indeterminate Solutions; L'Hopitals's Rule;

Function Approximation:

Fundamentals; limiting Indeterminate Analytical Functions; Taylor's and Maclaurin's Series; Composite Series Approximations; Accuracy Limitations

Supplementary Notes: None.

Learning Outcomes:

- Understanding of the concept and forms of, and motivation for complex numbers.
- The ability to represent complex numbers in Cartesian, exponential and graphical forms.
- The ability to perform fundamental arithmetic operations on complex numbers.
- The ability to measure the modulus and argument of a complex number.
- The ability to use complex arithmetic to represent the roots of any number.
- Understanding of the concept of vector arithmetic.
- The ability to manipulate high-dimensional mathematical objects and apply fundamental arithmetic operations thereon.
- An understanding of the form and concepts behind manipulation of matrices.
- The ability to perform fundamental arithmetic operations on matrices.
- The ability to transform matrices.
- The ability to exploit matrices for the solution of linear algebraic equations.
- The ability to perform matrix triangularisation and inversion.
- The ability to use matrix triangularisation, matrix inverse and matrix determinants to solve systems of simultaneous equations.
- Differentiation of simple, parametric and logarithmic functions
- 1st and 2nd order differential equations
- Integration of functions of functions, functions of linear functions, by parts, substitution or reduction
- Sequences and series
- Functional approximation

Skills

- Formulation and analysis of arithmetic problems including complex numbers.
- The ability to derive the roots of any number.
- Formulation and manipulation of high-dimensional mathematical objects.
- Formulation and solution of high-dimensional linear algebraic problems using matrix arithmetic.

ELE 1056 – Electrical Engineering

Course Detail

Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Components: Lecture Required, Practical Required, Tutorial Required
Assessment: Coursework 40%, Paper 60%
Pre-Requisites: None
Co-Requisites: None
Compulsory Element: Laboratory

Course Contents

Lectures:

1. History of Electrical Science
2. Electrostatics and Electromagnetism
3. Capacitance and Inductance
4. International Unit System
5. Analogue instruments

6. Digital instruments
7. Electric Power (Active, Reactive, Apparent)
8. Alternating Voltage and Current (Phasors, Analysis of simple circuits)
9. Energy resources and electrical generation
10. Economic and safety aspects of power supply systems
11. Practical transformers (Efficiency, Regulation)
12. Transmission of electricity (Voltage regulation)

Laboratory classes:

1. Electromagnetism
2. Instrumentation
3. Electrical Power
4. Transformer

Supplementary Notes: none

Learning Outcomes:

General:

- Understanding of electrical engineering fundamentals, including electromagnetism and measurements
- Introduction to electrical power generation, transmission and distribution

Laboratories:

- Practical understanding of electrical phenomena, electrical power, operating instruments, analysis and interpretation of results

Skills:

General:

- Analysis of electromagnetic systems
- Analysis of electric power systems
- Use of electrical/electronic engineering principles to develop solutions
- Presentation of technical engineering information clearly and concisely in written form

Laboratories:

- Operation of electrical / laboratory instruments
- Measurement of key characteristics of electrical systems
- Debugging of electrical systems
- Testing of electrical systems

ELE 1057 – Signals and Communications

Course Detail

Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Components: Lecture Required, Practical Required
Assessment: Coursework 60%, Class Test 20%, Practical 20%
Pre-Requisites: None
Co-Requisites: None
Compulsory Element: None

Course Contents

Linear Time Invariant Systems:

- Discrete and continuous time signals and systems.
- Simple signal arithmetic and manipulation
- Transformations of independent variables
- Properties of systems, including linearity, time invariance, stability, memory, causality
- Linear-time invariant (LTI) systems, convolution and impulse response
- Basic electronic data capture
- Fundamental data representation and manipulation
- Basic programming skills – program creation and execution
- Fundamental programming constructs: variables, structures, loops, conditionals.

Communications Systems:

- Overview of communication systems, electromagnetic spectrum
- Gain, Attenuation, Decibels and their use
- Analogue modulation: Amplitude Modulation (AM) Frequency Modulation (FM)
- Digital Modulation ASK, FSK, PSK
- Radio Receivers: Superheterodyne Receivers, Software defined radios, Filters
- Radio transmitters
- Noise, understanding N = kTB
- Transmission Lines
- Antennas
- Link Design Equation
- Propagation – Line of sight, Multipath Effects
- Optical Communications – eg Fibre "broadband"
- Introduction to Secure Communications

Supplementary Notes: none

Learning Outcomes:

On successful completion of this module, students will be able to:

- Understanding of the forms of continuous and discrete-time signals.
- Understanding the nature of transformations of a signal's independent variable.
- Comprehensive understanding of the nature of fundamental signals, specifically the discrete-time impulse and continuous-time exponential.
- Understanding of the nature of LTI systems.
- The ability to analyse LTI systems to determine any one of input, output or system response, given knowledge of the other two.
- Manipulate practical electronic data via software.
- Appreciation of communications systems used in a wide range of applications, eg mobile comms, satellite, aviation, emergency services, telemetry etc.
- Understand how information is conveyed wirelessly from transmitter to receiver including modulation, antennas and propagation
- Understanding of transmission lines and landline-based comms systems, such as fibre "broadband"
- Ability to design a basic analogue or digital wireless comms system including link design equations
- Practically measure communication system components and links

Skills:

- Discrete and continuous time signals and system description and transformation.
- Properties of systems, including linearity, time invariance, stability, memory, causality
- Linear-time invariant (LTI) systems, convolution and impulse response
- Basic signal capture, analysis and manipulation in software.
- Practical measurement skills of RF time domain and frequency domain
- Ability to specify, setup and measure a basic wireless communications system

STAGE 2

CSC 2034 - Year of Professional Experience
Course Detail
Career: Undergraduate
Units: 120.00
Grading Basis: Pass/Not Pass
Course Components: Work Placement/Experience Required
Assessment:
Pre-Requisites: None
Co-Requisites: None
Compulsory Element: Students must, unless exempt spend the year preceding their Level 3 year in obtaining professional experience in a manner approved by the Placement Team.
The placement normally lasts for a period of twelve months, during which time the student is a full employee and subject to all the requirements of the employer. Students must complete a minimum 9 month placement to satisfy University requirements.
Course Contents: The Professional Experience Year is a compulsory part of the academic programme for students on seven of our degree courses:

- BSc/BEng in Computer Science including Professional Experience
- MEng in Computer Science including Professional Experience
- BEng/Meng in Electronic & Software Engineering including Professional Experience
- BSc Business Information Technology including Professional Experience
- BSc Computing and Information Technology including Professional Experience

Supplementary Notes: None
Learning Outcomes: The overall aim of the industrial placement period is to provide the student with experience in computing/business which complements the academic study in the University and contributes to their professional development. Precise objectives to achieve this aim vary from placement to placement.
Ideally the students should:

- Understand the operation of industrial, commercial or government service organisations and the nature and importance of the business/computing dimension within them.
- Understand the systems of communication, control and responsibility within the organisation.
- Understand the systems of software quality control within the organisation.
- Acquire experience of working with other people at all levels.
- Have an appreciation of the organisational and administrative principles of running a business, particularly in the areas of financial control, costing and marketing (where appropriate and possible).
- Further develop their personal communication skills; good use of language, accurate writing and appropriate style and manner are required.
- Learn how they can best contribute to the organisation and develop their potential and self-management; appropriate application of initiative should be encouraged.
- Gain experience in carrying out computing/business tasks and thus acquire confidence in applying their knowledge to the solution of real problems; in keeping with this, they should be given progressively increasing responsibility.
- Understandably, students on placement will engage in widely differing activities. However, the great majority of placements allow achievement of the objectives above to a greater or lesser extent. Flexibility in arranging the placement programme is an essential requirement of many employers and the University recognises this, aiming for the maximum benefit to student and employer.

Skills:
This module provides an opportunity to exercise aspects of the following QCA Key Skills (at proficiency Level 4): Communication, Team Work, ICT Improving Own Learning, Problem Solving, Business Awareness, Project Management and Professionalism within the Workplace.

CSC 2051 – System Administration and Support

Course Detail
Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Components: Lecture Required, Practical Required
Assessment: Class Test 60%, Project 40%
Pre-Requisites: None
Co-Requisites: None
Compulsory Element: Normally, all elements of summative assessment must be attempted.
Course Contents: An introduction and overview to the common areas of systems administration and support focusing on Hardware and Windows-based systems along with SoHo networking principles (routers, wifi, etc).
Supplementary Notes: None
Learning Outcomes

- Identify, understand, and troubleshoot all major PC components
- Understand the process, planning, and execution of upgrading PC hardware
- Be able to work safely with hardware
- Install, upgrade, maintain, and update Windows operating systems and common applications
- Manage and maintain storage systems on a PC within Windows
- Manage user accounts on Windows systems
- Understand and use enterprise features of Windows Server including distributed storage, backup, file shares, and recovery processes
- Understand and apply knowledge of Active Directory including planning and implementation of suitable models
- Understand SoHo networking including SNAT and DNAT

Skills

- PC Procurement and Upgrade
- Windows Network Administration
- Windows Server Administration
- Small Network Administration
- Troubleshooting IT Systems
- Active Directory Planning

Develop interpersonal personal skills, problem solving and analytical. Effectively communicate technical issues to a mixed audience.

CSC 2052 – Server Side Web Development

Course Detail
Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Components: Lecture Required, Practical Required
Assessment: Project 100%
Pre-Requisites: None
Co-Requisites: None
Compulsory Element: Normally, all elements of summative assessment must be attempted.
Course Contents

- Software Design: Object-oriented design, Agile and Lean software design (iterative development, lean development principles).
- User Experience design (web UI frameworks and standards).
- Software Process: Contemporary web programming, Agile and Lean development practices, web server configuration management, database management.
- Database principles: Design, schema and querying.
- Security: Secure Design Principles, Developing secure software (secure coding practices)
- Web programming languages.

Supplementary Notes: None
Learning Outcomes

- Apply agile and lean principles to design, develop and test dynamic web-based software applications.
- Use a range of object-oriented design and programming skills to develop web software that demonstrates proficient programming skills and good object-oriented architectural design skills.
- Appropriately use contemporary web programming features (performance, optimization and rendering).
- Develop code and systems that are both secure and efficient.

Skills:

- Programming, Problem Solving, Time management, Communication Skills, Logical thinking.

CSC 2053 – Introduction to Enterprise Computing

Course Detail
Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Components: Lecture Required, Practical Required
Assessment: Project 50%, Timed Exam on Computer 50%
Pre-Requisites: None
Co-Requisites: None
Compulsory Element: Normally, all elements of summative assessment must be attempted.
Course Contents:
An introduction to modern concepts and systems used in Enterprise (large scale) computing including cloud computing. Linux will be introduced and explored both as an OS and for shell principles. Concepts of cloud computing including containerisations and clusters will be used in a hands-on manner. General concepts such as resilience and redundancy will be explored especially in connection to data centre designs and critical systems.
Supplementary Notes: None
Learning Outcomes

- Install, upgrade, maintain, and update Linux operating systems and common services
- Understand and use virtualisation technologies including their role in enterprise data centres
- Use Linux shell scripting to manipulate data and perform administrative functions
- Understand the processes for secure communication with networked systems including asymmetrical keys and secure sockets
- Understand the application of metrics and monitoring within an IT infrastructure
- Understand the role of key elements of the modern data centre and be able to make suitable decisions on architecture
- Understand and apply resilience terms and measures including redundancy
- Understand in general the trend towards cloud computing and the offerings made by vendors
- Understand the concepts of containerisation

Skills:
Shell scripting; Container architecture; Data centre design; Systems resilience planning; Monitoring of critical systems.

CSC 2054 – User Experience Design

Course Detail
Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Components: Lecture Required, Practical Required
Assessment: Project 100%
Pre-Requisites: None
Co-Requisites: None
Compulsory Element: Normally, all elements of summative assessment must be attempted.
Course Contents

- Ergonomics: ergonomics; accessibility; minimising mistakes; analysis and testing; case studies.
- Human Factors: human senses; human movement and speech; human memory; human intellect
- Prototyping: types of prototyping; low fidelity prototyping; exercise; high fidelity prototyping.
- Design Principles: universal design; principles and guidelines; interaction styles; patterns.
- User Interfaces: design implementations of human cognition; layout; navigation; text.
- Usability Metrics: usability; assessment; qualitative assessment; quantitative assessment.
- Usability Heuristics: heuristic evaluation, usability heuristics; specialised heuristics.

Supplementary Notes: None
Learning Outcomes - Be able to:

- Demonstrate understanding of the role of human factors, effective design, prototyping and usability evaluation in the development of software and hardware products.
- Develop appropriate user interfaces for specific applications and specific users using low and high-fidelity prototyping.
- Assess the usability of an application with respect to different user populations.
- Work as a member of a team to deliver designs and prototypes.

Skills:
Communication, Improving Own Learning and Performance, Problem Solving, Working with Others

CSC 2056 – Systems Security and Cryptography

Course Detail
Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Components: Lecture Required, Practical Required
Assessment: Class Test 1 50%, Class Test 2 50%
Pre-Requisites: None
Co-Requisites: None
Compulsory Element: Normally, all elements of summative assessment must be attempted.
Course Contents: This module will introduce fundamental concepts in cyber security, including vulnerabilities, threats and attacks, principles of secure design, and cryptography. By the end of this module students should grasp the core principles of secure information system design, be aware of the current threats and challenges to the security of information systems, data, and services, and understand the application of cryptographic algorithms for confidentiality, integrity, and authentication.

- Security and Vulnerability
- Introduction to modern cryptography
    - Confidentiality, integrity and availability
    - Symmetric cryptography and Public key cryptography
    - Authentication and access control
    - Use of cryptography in information systems
- Introduction to secure information system design
- Threats and challenges in cyber security
    - Human threats/social engineering

    - Physical layer attacks
- System protection technologies and countermeasures

Supplementary Notes: None

Learning Outcomes

- Identify and analyse the current threats and challenges to the security of information systems, data, and services,
- Evaluate system protection technologies and methods,
- Apply knowledge of cryptographic algorithms to provide confidentiality, integrity, and authentication.

Skills: Problem solving, communication skills, time management, practical skills (including a base understanding of cryptography and challenges in cyber security).

CSC 2057 – Modern Web App Development

Course Detail

Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Components: Lecture Required, Practical Required
Assessment: Continual Assessment 30%, Project 70%
Pre-Requisites: CSC1024 Programming and Systems Development
Co-Requisites: None
Compulsory Element: Normally, all elements of summative assessment must be attempted.
Course Contents: Web developers work with a combination of different technologies, e.g. server-side scripting languages, JavaScript, SQL and they may also specialise in other web development stacks. The course will explore one modern server-side programming language with the traditional client-side technologies such as JavaScript and CSS that are used in developing modern dynamic web applications. Further to this, other areas of software engineering will also be studied in order to implement real-world and web-based software solutions.
Supplementary Notes: None
Learning Outcomes: Students shall be able to:

- Demonstrate knowledge and understanding of the principles of web development technologies to include:
    - Principles of Python programming for web deployment
- Demonstrate knowledge and understanding of the principles of the associated technologies that support web-based application development to include:
    - Practices of client-side technologies e.g. JavaScript, HTML and CSS.
    - Practices of RDBMS e.g. SQL and MySQL.
- Demonstrate the ability to build and deploy real-world web-based software solutions to include:
    - Principles of solution-based design
    - Practices of software system development, deployment and testing
    - Principles of performance, optimization and rendering.

Skills:

KNOWLEDGE & UNDERSTANDING:

- Understand the fundamentals of several modern, open-source server-side programming language.
- Understand the fundamentals of the following areas in web development: web based software system design, full stack development, and web based application deployment.
- Understand the fundamentals in software engineering: development methodologies, testing and security.

CSC 2058 – Software Engineering and Systems Development

Course Detail

Career: Undergraduate
Units: 40.00
Grading Basis: Graded
Course Components: Lecture Required, Practical Required
Assessment: Project 100%
Pre-Requisites: CSC1027 Programming **OR BOTH** CSC1025 Procedural Programming and CSC1029 Object-Oriented Programming
Co-Requisites: CSC2059 Data Structures & Algorithms
Compulsory Element: Normally, all elements of summative assessment must be attempted.
Course Contents:

- Software development as teamwork; roles and responsibilities within a team.
- The software engineering process: eliciting and specifying requirements – functional and non-functional; analysing, designing, implementing and testing software systems; deployment; maintenance.
- Software Engineering in the context of sustainable development:
  - Understanding complex real world problems from a social, economic and environmental prospective;
  - Designing sustainable real-world solutions that have a significant software element and that aspire to address the tensions between conflicting concerns.
- Contemporary software development methodologies – including:
  - use-case-driven and model-based approaches; representing actors and aspects of system behaviour and architecture in the Unified Modelling Language (UML) ;
  - agile and lean approaches; user stories, story estimation, sprints (planning, monitoring and review);
  - hybrid approaches – e.g. combining use cases and stories.
- Specific software development techniques, tools and practices – including:
  - version control software; automated tests and test-driven development; pair- and mob-programming; test coverage; continuous integration, delivery and deployment; DevOps.
- Specific investigative and problem-solving techniques, including:
  - Team-based, collaborative learning as part of a process of identifying and designing innovative sustainable solutions to problems identified from authentic case studies;
  - Gamification, game-based learning and simulation as means of representing key aspects of real-world problems and the steps in the process of formulating sustainable, software-supported, real-world solutions.
- Object-oriented design principles: evaluating the quality of a software design; questions of coupling and cohesion; configuring mechanisms of collaborating software objects.
- UI design principles: evaluating the quality of an interface design; usability and the user experience.
- Algorithmic design: formulating and representing stepwise solutions to a problem.
- Building security into the development process; awareness of and avoidance of vulnerabilities.
- Delivering reliable and secure working systems – from design to working software

Supplementary Notes: None
Learning Outcomes:

- Work as a member of a collaborative, mutually supportive team.
- Actively develop and deliver a non-trivial, well-engineered software system that meets its functional and non-functional requirements, including avoidance of software vulnerabilities – the software system may take the form of a game, based on a real-world problem and the process of designing its solution;
- Demonstrate an ability to confront, manage and shape contemporary social, economic and ecological conditions as part of the process of developing software systems;
- Understand key aspects of modern software development practices.
- Critically evaluate development challenges and resolve them methodically using appropriate techniques and tools.

- Realise object and algorithmic designs using an appropriate implementation language (e.g. Java, C#) and operating system (e.g. Windows, Android);
- Plan and implement a test strategy that incorporates automated tests (e.g. Junit, Visual Studio Test Explorer) and manual tests (e.g. user acceptance testing and evaluation);
- Use appropriate version and project management software (e.g. Git, Trello, Jira).

Skills:
Problem solving, (including the ability to analyse and mitigate problems that are characterised by change, uncertainty, risk and complexity), time management, communication skills, team working, practical skills (competent use of development software and project management software in the context of a software engineering project).

CSC 2059 – Data Structures and Algorithms

Course Detail
Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Components: Lecture Required, Practical Required
Assessment: Continual Assessment 50%, Timed Exam on Computer 50%
Pre-Requisites: CSC1027 Programming **OR** CSC1029 Object Orientated Programming
Co-Requisites: None
Compulsory Element: Normally, all elements of summative assessment must be attempted.
Course Content:

- Data structures: Stacks, Lists, Queues, Trees, Hash tables, Graphs, Sets and Maps
- Algorithms: Searching, Sorting, Recursion (with trees, graphs, hash tables etc.)
- Asymptotic analysis of algorithms
- Programming languages representation and implementation

Supplementary Notes: None
Learning Outcomes

- Demonstrate understanding of the operation and implementation of common data structures and algorithmic processes (including stacks, lists, queues, trees, hash tables, graphs, sets and maps, alongside searching, sorting and recursion algorithms).
- Select, implement and use data structures and searching, sorting and recursive algorithms to model and solve problems.
- Perform asymptotic analysis of simple algorithms.
- Demonstrate understanding of the fundamentals of programming languages representation, implementation and execution.

Skills:
Problem solving by analysis, solution design and application of techniques (e.g. suitable data structures, algorithms, and implementation in C++). Precision and conciseness of expression. Rigour in thought.

CSC 2060 – Theory of Computation

Course Detail
Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Components: Lecture Required, Practical Required
Assessment: Continual Assessment 40%, Paper 60%
Requisites: CSC1026 Fundamentals of Maths for Computing
Co-Requisites: None
Compulsory Element: Normally, all elements of summative assessment must be attempted
Course Contents:

- Automata and Formal Languages
- Computability Theory (Turing Machines etc) and Decidability Theory (Halting Problem, etc)
- Complexity Theory

Supplementary Notes: None
Learning Outcomes

- Explain how computation can occur using automata such as finite state machines and Turing machines.
- Reason about algorithmic complexity and determine what problems can/cannot be solved by computers.
- Describe the correspondence amongst Languages and Automata etc.
- Use proof techniques to construct simple proofs.

Skills: Problem analysis, Problem solving. Precision and conciseness of expression. Rigour in thought. Constructing logical arguments and proofs

CSC 2062 – Introduction to Artificial Intelligence and Machine Learning

Course Detail
Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Components: Lecture Required, Practical Required
Assessment: Assignment 1 30%, Assignment 2 30%, Paper 40%
Pre-Requisites:
Co-Requisites: None
Compulsory Element: Coursework, Written examination.
Course Contents:

- Concepts of artificial intelligence and machine learning.
- Fundamentals of supervised and unsupervised learning
- Fundamentals of experimental settings and hypothesis evaluation
- The concept of feature selection
- Evaluation in machine learning
  - Type I and Type II errors
  - Confusion matrices
  - ROC and CMC curves
  - Cross validation
- Linear and non-linear function fitting
  - Linear Regression
  - Kernels
- Classification models:
  - Nearest Neighbour
  - Naïve Bayes
  - Decision Trees
- Clustering models:
  - k-Means
  - hierarchical clustering
  - Anomaly detection

Supplementary Notes: None
Learning Outcomes:

- Knowledge and understanding of techniques and selected software relevant to the field of artificial intelligence.
- Ability to identify techniques relevant to particular problems in artificial intelligence and data analysis.
- Ability to discuss and provide reasonable argumentation using artificial intelligence and machine learning concepts.
- Ability to identify opportunities for software solutions in artificial intelligence and data analysis.
- Ability to solve specific data analysis problems using techniques of artificial intelligence and machine learning.

Skills:
Problem and data analyses, design of logical and statistical models, application of computational techniques, understanding results

CSC 2063 – Service-Orientated Programming

Course Detail
Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Components: Lecture Required, Practical Required
Assessment: Project 70%, Timed Exam on Computer 30%
Pre-Requisites: CSC1027 Programming **OR** CSC1029 Object-oriented programming
Co-Requisites: None
Compulsory Element: Normally, all elements of summative assessment must be attempted.
Course Contents:
The module deals with the design and the development of software with service-oriented architecture (SoA). In particular, the module focuses on how software can be developed by designing well-separated and cohesive components (a.k.a. modular architecture) using SoA design principles. To make these components reusable over the Web, the module further illustrates how software components can be exposed using the current technology of Web services, accessed via Web APIs. Also, the module deals with the serialization techniques that service components use to exchange data to each other. The students will collaborate in small teams to build software as a composition of macro-services and/or micro-services.
Supplementary Notes: None
Learning Outcomes:
Students must be able to demonstrate knowledge and understanding on:

- Designing (modular) service-oriented architecture software
- Applying SoA design principles
- Using the current technology of Web services
- Defining Web APIs
- Employing serialization techniques
- Designing service compositions
- Collaborative development of SoA team projects

Skills:
The skills acquired after completing the module are the following:

- The design and the development of service-oriented architecture software
- The usage of the current technology of Web services (RESTful and SOAP services)
- The design of reusable software components
- The definition of JSON and XML Web APIs
- The employment of serialization techniques (e.g. Java to JSON/XML and vice versa) for the data exchange between Web services
- The collaborative SoA software development

CSC 2065 – Professional and Transferrable Skills

Course Detail
Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Components: Advisory Required, Lecture Required, Practical Required
Assessment: Continual Assessment 100%
Pre-Requisites: None
Co-Requisites: None
Compulsory Element: None
Course Contents:
This module will prepare students for employment by developing an awareness of the business environment and the issues involved in successful career management combined with the development of key transferrable skills such as problem solving, communication and team working.

Students will build their professional practice and ability to critically self-reflect to improve their performance.
Key elements will explode legal, social, ethical and professional issues (LSEPIs) including intellectual property, computer-aided crime, data protection and privacy including GDPR, security, net neutrality, communication through technology, cultural sensitivity and gender neutrality. The British Computer Society (BCS) code of conduct will be exploded and understood.
Supplementary Notes: None
Learning Outcomes:

- To prepare students for employment in industry and research through developing an awareness of the business environment and key skills.
- To develop and demonstrate a range of transferrable skills including communication skills, presentation, group working and problem solving.
- To develop skills in critical reflection of self and others feeding into improvements.
- To explore legal, social, ethical and professional issues (LSEPIs). Examples of areas to be explored will relate to: Intellectual Property, Computer Crime, Work Quality, Challenges of On-line content Quality, Digital Divide including Net Neutrality, Privacy including GDPR, Security, Globalisation, Communication through effective use of technology, Cultural Sensitivity, Gender Neutrality. British Computer Society (BCS) Code of Conduct will be explored covering Public Interest, Professional Competence and Integrity, Duty to Relevant Authority and Duty to the Profession.

Skills: Problem synthesis and resolution as an individual and as part of a team. Development and use of suitable communication mechanisms. Business and Professional awareness

CSC 2066 – Networks and Protocols

Course Detail
Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Components: Lecture Required, Practical Required
Assessment: Continual Assessment 100%
Pre-Requisites: None
Co-Requisites: None
Compulsory Element: None
Course Contents:

- Networking fundamentals, classifications and protocols
- The Internet and World Wide Web including Client-Server approach
- Computer Network layers
- Routing including OSPF and BGP
- Local Area Network Topologies/Wireless Networks
- Common Internet application protocols including HTTP and HTTPS
- Software-Defined Networks
- Socket-based connections
- Selected networking topics e.g., Network Security, Wireless Networks, Network Resources

Supplementary Notes: None
Learning Outcomes:

- Describe Computer Network layers and models such as OSI, TCP/IP.
- Describe common network protocols including TCP/IP suite e.g. IP/TCP/UDP.
- Demonstrate knowledge and understanding of routing algorithms and scalable routing.
- Demonstrate knowledge and understanding of common Internet application protocols as well as client-server network architectures.
- Demonstrate knowledge and understanding of software-defined networks.
- Demonstrate knowledge and understanding of security and resource consumption in networking.

Skills:

Improving Own Learning and Performance, Problem Solving, planning and researching assignments, design and implementation of solutions

ECS 2039 – Digital Systems

Course Detail
Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Components: Lecture Required, Practical Required
Assessment: Coursework 35%, Exam 40%, Laboratory Project 25%
Pre-Requisites: None
Co-Requisites: None
Compulsory Element: None
Course Contents:
This course will cover the design of complex digital systems based on the skills that developed in ECS1005. The course will include addressing the implementation of both combinational and sequential circuits. A significant number of technical design exercises and a project for the applications in the real digital world will be also included. The module will be delivered into two parts in two semesters, theoretical-based (first semester) and application-based (second semester) contents.
The first part (theoretical based) will deliver the following contents:

- Technologies
  - Processors, GPU, AI processor
  - Programmable logic devices
  - Application specific integrated circuit (ASIC)
  - Field programmable gate arrays (FPGAs)
- Hardware Description Language
  - Development of Verilog source code
  - Verilog simulation
  - Logic synthesis
- Multiple-output Circuits
  - Combinational logic revision
  - Minimisation of multiple-output circuits, Petricks Method
  - Tabular determination of multiple output
- Sequential Circuits
  - Synchronous sequential systems
  - Finite state machine analysis
  - Moore and Mealy models
  - State reduction techniques
- Fault Detection/Design for Testability
  - Faults, controllability, and observability
  - Fault detection
  - Design for testability

The second part (application-based), the FPGA based labs with Verilog HDL, will enhance the digital design concepts in the students understanding, via a hands-on approach. This will include 5 structured labs introducing the students to the basic language constructs for modelling both the combinational and sequential elements of a digital design, as well as the optimization strategies for an efficient design by benchmarking in terms of the recourse usage and the operating frequency of an algorithm on an FPGA device. The methodology to communicate with the basic interfaces of the FPGA board will also be undertaken
The contents are as follows:

- Introduction to Xilinx Vivado Design Tool
- Simulating a design
- Constraints and TCL scripts
- Synthesize and Implementation

- Debugging a design
- Generating and downloading a bitstream onto a demo board
- Analysing Vivado reports

Supplementary Notes: None

Learning Outcomes:

The module will provide a comprehensive understanding and application of digital system design through practical digital hardware circuit design and programming skills using Verilog HDL programming. After the completion of this module, students will be able to:

- Design, implement and analyse complicated digital circuits
- Simulate, synthesis and implement practical circuits
- Design and implement a digital circuit design on FPGAs
- Analyse the performance of a digital circuit design through a design tool's report.

Skills:

During this course of this module you will acquire the following key skills:

- How to design, verify, synthesis and analysis a design.
- Problem solving/debugging a real FPGA system
- ICT skills
- HDL programming skills

ELE 2019 - Electrical Power Engineering 2

Course Detail

Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Components: Lecture Required, Practical Required
Assessment: Coursework 10%, Paper 70%, Practical 20%
Pre-Requisites: None
Co-Requisites: None
Compulsory Element: Laboratory
Course Contents:

Lectures:

- Electrical machine fundamentals: Magnetic field theory; Faraday's Law and induced force; A linear DC machine – a simple example
- The DC machine: EMF and torque production; DC machine Commutation; Development of equivalent circuit; Speed control and machine construction.
- The induction machine: rotating field theory; induction machine construction; measurement of machine parameters; Torque and power, torque-speed characteristic, power flow and efficiency; modification of machine characteristics, speed control, machine starting
- Other machines; Analysis of simple universal motor; Single-phase induction machines
- Three-phase quantities: line and phase voltage and currents; power in 3-phase circuits; Real power, Reactive Power, Apparent Power and Power Factor
- Per-Unit System: Definitions & reasons; change of base; transformer representation
- Synchronous Generation: equivalent circuit; generation on infinite busbars; steady-State & Transient Operation; performance Chart
- Transmission Lines: Two-port network representation; Short line representation; Medium line representation by Nominal & Equivalent T and pi; long line representation by Telegraphers equations
- Load Flow Analysis: Node type definitions; Gauss-Seidel method of solution; methods of Voltage & Reactive Power Control
- Symmetrical Components: definitions; asymmetric Fault Analysis by Symmetrical Components

Laboratory classes:

Electrical Machines (induction, DC and Synchronous), transmission line and load flow

Supplementary Notes: None

Learning Outcomes:
After the completion of this module you will be able to:

- Understand rotating field theory and electromagnetism
- Apply circuit theory for solving machine equations.
- Use equivalent circuits to analyse machine performance under various condition, e.g., start up, short circuit, breaking etc.
- Undertake machine performance testing.
- Familiarisation with the Per-Unit system
- Understand Synchronous machine operation under steady-state & transient conditions
- Familiarisation with transmission network representation
- An understanding of Load Flow analysis and methods of reactive power compensation and voltage control
- A method of asymmetric fault analysis

Laboratory Classes:

- Practical understanding of the operation & characteristics of different electrical machines
- Experience of modern instrumentation and computer-aided power system simulation & analysis

Skills:
During this course of this module you will acquire the following key skills:

- Numeric skills
- Analytical techniques
- Perform experimental work

ELE 2025 - Embedded Systems 2

Course Detail
Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Components: Lecture Required, Practical Required
Assessment: Laboratory Coursework 50%, Design Project 50%
Pre-Requisites: None
Co-Requisites: None
Compulsory Element: None
Course Contents:

1. Introduction to Microcontrollers for Embedded Systems
2. Interfacing Sensors for Microcontrollers
3. Design Project for Microcontroller based Hardware

Supplementary Notes: None
Learning Outcomes
On successful completion of the course the student will:

- Understand the process of programming microcontrollers.
- Understand the basic hardware structure of a microcontroller.
- Understand analogue and digital interface circuits for microcontrollers.
- Understand how to interface sensors to microcontrollers.
- Understand how to design and construct a microcontroller hardware project.

Skills: The skills developed by the students during this course are as follows:

- How to use an IDE (Integrated Development Environment) for developing microcontroller software.
- Understand how to edit, compile and test/debug simple programs.
- Understand how to design simple embedded systems to solve real-world problems.
- Develop communication skills for working in a team.
- Develop project management skills for working in a team.

ELE 2034 - Sandwich - Year of Professional Experience

Course Detail

Career: Undergraduate
Units: 120.00
Grading Basis: Pass/Not Pass
Course Components: Work Placement/Experience Required
Assessment:
Pre-Requisites: None
Co-Requisites: None
Compulsory Element: Students must, unless exempt, spend the year preceding their Level 3 year in obtaining professional experience in a manner approved by the Placement Team.
The placement normally lasts for a period of twelve months, during which time the student is a full employee and subject to all the requirements of the employer. Students must complete a minimum 9 month placement to satisfy University requirements.
Course Contents
The Professional Experience Year is a compulsory part of the academic programme for students on seven of our degree courses:

- BSc/BEng in Computer Science including Professional Experience
- MEng in Computer Science including Professional Experience
- BEng/MEng in Electronic & Software Engineering including Professional Experience
- BSc Business Information Technology including Professional Experience
- BSc Computing and Information Technology including Professional Experience

Supplementary Notes: None
Learning Outcomes:
The overall aim of the industrial placement period is to provide the student with experience in computing which complements the academic study in the University and contributes to their development as a fully educated computer scientist or information technologist.
Precise objectives to achieve this aim vary from placement to placement. Ideally the students should:

- Understand the operation of industrial, commercial or government service organisations and the nature and importance of the computing dimension within them.
- Understand the systems of communication, control and responsibility within the organisation.
- Understand the systems of software quality control within the organisation.
- Acquire experience of working with other people at all levels.
- Have an appreciation of the organisational and administrative principles of running a business, particularly in the areas of financial control, costing and marketing (where appropriate and possible).
- Further develop their personal communication skills; good use of language, accurate writing and appropriate style and manner are required.
- Learn how they can best contribute to the organisation and develop their potential and self-management; appropriate application of initiative should be encouraged.
- Gain experience in carrying out computing tasks and thus acquire confidence in applying their knowledge to the solution of real problems; in keeping with this, they should be given progressively increasing responsibility.

Understandably, students on placement will engage in widely differing activities, however, the great majority of placements allow achievement of the objectives above to a greater or lesser extent. Flexibility in arranging the placement programme is an essential requirement of many employers and the University recognises this, aiming for the maximum benefit to student and employer.
Skills:
This module provides an opportunity to exercise aspects of the following QCA Key Skills (at proficiency Level 4): Communication, ICT Improving Own Learning and Performance, Problem Solving, Business Awareness, Project Management, Teamwork.

ELE 2035 - Mathematics

Course Detail
Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Components: Lecture Required, Tutorial Required
Assessment: Class Test 20%, Coursework 20%, Paper 60%
Pre-Requisites: None
Co-Requisites: None
Compulsory Element: None
Course Contents:

1. Periodic functions, Fourier series and Fourier coefficients.
2. Vector/matrix notations and operations.
3. Fundamental theorem of linear systems, solving linear systems.
4. Orthogonality, eigenvalues, eigenvectors, eigendecomposition, and QR decomposition.
5. Multivariate functions, partial derivatives, chain rule.
6. Multivariate integration.
7. Multivariate optimisation: unconstrained optimisation and constrained optimisation.
8. Basic Probability Concepts and Common Probability Distributions.
9. Sampling, Parameter Estimation, Statistical Inference.

Supplementary Notes: Sample papers, C++ revision notes, code examples
Learning Outcomes:
Fundamental understanding of the modern engineering mathematics, probability and statistics, basic theoretical concepts, methods, with application to the problems of analysis and modelling in electronic communications, microwave engineering and design of electronic components, circuits and systems.

Understand basic probability concepts, expectation and some of the most common probability distributions encountered in engineering. Understand different concepts related to sampling and data analysis. Build an appreciation of some of the different types of parameter estimation. Develop an understanding of the principles of statistical inference including hypothesis testing.
Skills:

- Matrix algebra, analysis and modelling of linear systems.
- Fourier analysis
- Optimisation theory
- Multivariate calculus
- Probability and statistical inference
- Computational statistics.

ELE 2037 – Employability Skills and Placement Preparation

Course Detail
Career: Undergraduate
Units: 0.00
Grading Basis: Graded
Course Components: Lecture Required, Placeholder Required
Assessment:
Pre-Requisites: None
Co-Requisites: None
Compulsory Element: All stage 2 EEE/CE students are automatically enrolled on this module. Since it is not credit bearing and does not contribute to the degree classification, successful completion of this module is assessed via attendance.
Students intending on undertaking placement at the end of Year 2/3 need to attend at least 2 out of the 4 scheduled sessions which must include Placement Approval Process and Professionalism in the Workplace as well as 2 workshops on Interviews and Assessment Centres/Team Work.

NB.
• The result will be displayed as a Pass/Fail on the degree transcript.

• A register of attendance will be collated at each session.
• Only students who pass this module will be permitted to enrol on the ELE2034/ELE3034 Year of Professional Experience placement module.

Course Contents:

This module will prepare students for placement and graduate employment by developing an awareness of the business environment and the issues involved in successful career management combined with the development of key transferrable skills such as problem solving, communication and team working. Students will build their professional practice and ability to critically self-reflect to improve their performance.

Lectures will include:

- Introduction to placement requirements
- CV building, local, national and international options
- Interview skills
- Assessment centres
- Placement approval
- Health and safety and wellbeing.

Interactive workshops will focus on interview skills and team work.

This module will be delivered in-house by EEECS Careers & Placement Team.

Supplementary Notes: Students must successfully pass this module prior to being enrolled on ELE2034/ELE3034 Year of Professional Experience Module.

Learning Outcomes:

- To prepare students to compete effectively for placement and graduate employment in industry
- Become more aware of their career aspirations and how to achieve them.
- Develop knowledge of undergraduate and graduate opportunities both locally, nationally and internationally.
- To develop and demonstrate a range of transferrable skills including communication skills, presentation, group working and problem solving.
- To develop professional skills in critical reflection of self and others feeding into improvements.

Skills:

- Equips students with a clear understanding of placement requirements and the placement approval process.
- Develop practical experience of communication skills, presentation skills and team working skills.
- Gain a wider understanding of the business environment and the opportunities available within the Engineering and IT sectors.
- Manage own career decision making.

ELE 2038 – Signals and Control

Course Detail

Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Components: Lecture Required, Practical Required
Assessment: Coursework 40%, Examination 50%, Laboratory Project 10%
Pre-Requisites: None
Co-Requisites: None
Compulsory Element: Laboratory

Course Contents:

Signals: First, we will introduce Continuous Time (CT) and Discrete Time (DT) signals, their mathematical representations, and their classifications (power, energy, periodic, aperiodic, odd & even, etc). Following, we will cover transformations to signal independent variables: shifting, time-reversal, time scaling etc. Once the basic signal concept is covered, we will investigate building blocks for signal analysis: We will introduce CT and DT exponential signals (real and imaginary) and

their sinusoidal representations in complex basis. Finally, we will cover unit impulse and step signals & their applications. Next, we will introduce the systems concept: We will talk about CT and DT systems, we will interconnect CT and DT systems, and we will understand the concepts of memory, time-reversal, inversion, causality, stability, time invariance and linearity with respect to CT and DT systems. We will also cover system algebra and block diagram representation of series, parallel and feedback type CT and DT systems. Once the basic system concept is covered, we will be ready to discuss Linear Time-Invariant (LTI) systems concept: We will understand the nature of LTI systems, we will cover, in detail, the convolution theory and its application to CT & DT signals, understand the concept of convolution sum representation of DT systems and convolution integral representation of CT systems, learn the properties of LTI systems (i.e. commutativity, distributivity, associativity, memory, inevitability, causality, stability). Finally, we will learn how to calculate the output and impulse response of CT systems using linear constant coefficient differential equations (and of DT systems using linear coefficient difference equations). At this point, we will have developed a comprehensive understanding of signals and systems in time-domain. Next, we will learn about Fourier transform: We will understand the nature and purpose of the Fourier Transform, we will investigate the restrictions on the applicability of Fourier transform analysis, and we will cover the convergence properties of the Fourier transform. We will then investigate the properties of the Fourier Transform (linearity, time-reversal, time-shift, time-scaling, Parseval's relation, etc). We will, then, understand and apply the Fourier transform duality between multiplication and convolution. Finally, we will cover Fourier transform analysis of CT and DT LTI systems. Next, we will learn the sampling theory: We will understand how sampled signals are derived, investigate the frequency spectra of sampled signals, understand what is meant by "Nyquist rate" and "aliasing", and finally, understand the effect of sampling rate in signal reconstruction. Next, we will cover Z-transform: We will derive the Z-transform representation of a DT signal and understand the concept of region of convergence in z-transform. Following, we will cover the properties of the Z-transform (linearity, Z-domain scaling, accumulation, differentiation, etc). We will apply Z-domain analysis to determine properties of LTI systems, to determine difference equation representations of DT LTI systems, and finally, to derive DT LTI system block diagrams.

Control: We will introduce the concept of a dynamical system: a mathematical abstraction of a physical, chemical, biological, economic, or other entity where we study the evolution of certain variables in time. We will use first principles of science and engineering to build dynamical systems and write them in a state space representation. Taylor's theorem will allow us to approximate nonlinear dynamical systems. Next, we shall introduce the Laplace transform and its inverse that offer a systematic approach for solving linear differential equations and lay the theoretical foundations for a structured study of linear dynamical systems. This will allow us to describe linear dynamical systems using the transfer function – a complex function – and study the dynamical properties of first and second-order systems. At that point we will be ready to introduce the concept of bounded-input bounded-output (BIBO) stability, state Routh's stability criterion and design BIBO-stable PID controllers. Lastly, we study the dynamic characteristics of linear systems upon sinusoidal excitation, introduce the celebrated Bode plots and revisit the problem of stability using frequency-based criteria.

Coursework:

1. Coursework assignment on signals and systems
2. Group coursework assignment on control and estimation theory

Labs:

1. Lab 1: Autonomous driving (lane keeping control) lab
2. Lab 2: Design of an inverted pendulum using system linearisation and PID controller design

Supplementary Notes: None

Learning Outcomes:

C1: Science and Mathematics

LO: Develop and apply analytical solutions to complex signals and systems related problems, covering LTI systems, Fourier analysis, sampling, and Z-transform.

Teaching: Lectures, tutorials

Assessment (in descending order of importance): Exam, Signals Coursework

LO: Gain a comprehensive understanding of numerical modelling and practical design of signals and communications systems and their engineering.

Teaching: Lectures, tutorials

Assessment: Signals Coursework
LO: Understand the basic components of a feedback control system and their role
Teaching: Lectures
Assessment (in descending order of importance): Exam, Control Coursework, Labs
LO: Model dynamical systems in the time and complex frequency domains
Teaching: Lectures, Control Labs
Assessment (in descending order of importance): Exam, Control Coursework, Labs
LO: Use the Laplace transform and its inverse to solve initial value problems
Teaching: Lectures, Control Labs
Assessment (in descending order of importance): Exam, Control Coursework, Labs
LO: Use Taylor's approximation theorem to linearise dynamical systems at an equilibrium point
Teaching: Lectures, Control Labs
Assessment (in descending order of importance): Exam, Labs, Control Coursework

C2: Problem Analysis

LO: Formulating and analysing complex problems to reach substantiated conclusions.
Teaching: Lectures, Tutorials
Assessment (in descending order of importance): Exam, Signals Coursework, Control Coursework, Labs
LO: Evaluating data and equations using engineering principles and numerical frameworks.
Teaching: Lectures, Tutorials
Assessment (in descending order of importance: Exam, Signals coursework, Control Coursework, Labs
LO: Evaluating and processing data analytically
Teaching: Lectures, Tutorials
Assessment (in descending order of importance): Exam, Signals coursework
LO: Use first principles of physics and engineering to describe real-life dynamical systems in the form of ODEs/IDEs while choosing appropriate frames of reference and simplifying assumptions.
Teaching: Lectures
Assessment (in descending order of importance): Exam, Control Coursework
LO: Analyse the behaviour of dynamical systems, their impulse, step and frequency response characteristics and their limit behaviour at infinite time with special emphasis on first and second order systems.
Teaching: Lectures
Assessment (in descending order of importance): Exam, Control Coursework

C3: Analytics Tools and Techniques

LO: Apply computational techniques using numerical simulations to study complex signal models.
Teaching: Lectures, Tutorials.
Assessment: Signals Coursework.
LO: Develop analytical techniques to solve problems related to LTI systems, Fourier analysis, Nyquist sampling, and Z-Transform.
Teaching: Lectures, Tutorials
Assessment (in descending order of importance): Exam, Signals Coursework
LO: Use appropriate stability criteria (such as Routh's tabulation, Bode's criterion or other) to tell whether a given system is stable in the BIBO sense
Teaching: Lectures, Control Labs
Assessment (in descending order of importance): Exam, Control Coursework

C5: Design

LO: Use appropriate stability criteria (such as Routh's tabulation, Bode's criterion or other) to tell whether a given system is stable in the BIBO sense.
Teaching: Lectures, Labs
Assessment (in descending order of importance): Exam, Control Coursework
LO: Design PID controllers to achieve certain performance criteria such as desired stability margins, or poles with an adequately negative real part
Teaching: Lectures, Control Labs
Assessment (in descending order of importance): Exam, Control Coursework

C6: Integrated/Systems approach

LO: Develop an appreciation of the system abstraction to model interconnected dynamical systems

and feedback loops
Teaching: Lectures
Assessment (in descending order of importance): Exam, Control Coursework

C12: Practical and Workshop Skills

LO: Use a numerical platform to simulate signals, systems and their analysis in the time domain, frequency domain and Z-domain.
Teaching: Lectures
Assessment: Signals Coursework
LO: Use Python to simulate dynamical systems and design control systems
Teaching: Labs
Assessment (in descending order of importance): Labs

C13: Materials, equipment, technologies, and processes

LO: Select and apply appropriate ways to numerically model signals and systems using a mathematical modelling environment.
Teaching: Lectures (practical examples)
Assessment: Signals Coursework
LO: Develop and apply appropriate analytical solutions to all aspects of signals and systems, from linear operations applied to continuous time and discrete time signals to Fourier transform and Z-transform.
Teaching: Lectures, Tutorials
Assessment (in descending order of importance): Exam, Signals Coursework

C15: Engineering and project management

LO: Ability to manage an engineering project, involving planning, distribution of tasks, collaborative development using technologies such as git, collaborating using issue trackers, etc.
Teaching: Lectures
Assessment (in descending order of importance): Control Coursework (Group assignment)

C16: Teamwork

LO: Ability to function effective as a member of a team (punctuality, responsibility, discipline, clear communication with other team members) tasked with the design of a control system
Teaching: Lectures
Assessment (in descending order of importance): Control Coursework (Group assignment)

C17: Communication

LO: Reporting of analytical and numerical results (in both Signals and Control). Through these activities, the students will learn communicating effectively on all aspects regarding signals and systems.
Teaching: Lectures (Q&A) and tutorials.
Assessment: Coursework assignments (Signals and Control)

Skills:

Upon completion of this module, the students will be able to:

1. Combine continuous-time and discrete-time signals
2. Manipulate fundamental signals, specifically discrete-time impulse, and continuous-time exponential
3. Convolve two signals
4. Analyse LTI systems to determine any one of input, output, or system response, given knowledge of the other two
5. Analyse systems in time-domain and frequency-domain, and the relationship between these two domains
6. Analyse systems in Z-domain
7. Design feedback control systems for linear SISO continuous-time systems using PID controllers
8. Solve engineering problems by breaking down the original problem into simple tasks, troubleshooting, debugging, and brainstorming
9. Collaborate with your fellow colleagues – perhaps the most valuable non-technical skills are collegiality and teamwork
10. Use appropriate software to simulate dynamical systems and perform symbolic computations

ELE 2040 – Communications

Course Detail

Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Components: Lecture Required, Practical Required
Assessment: Coursework 10%, Exam 75%, Laboratory Project 15%
Pre-Requisites: None
Co-Requisites: None
Compulsory Element: None
Course Contents:
Part 1 (Electromagnetics and Antennas)

- Fundamentals on Electromagnetics
- Waves
- Radiation - Fundamentals on Antennas
- Antennas
- Antenna arrays

Part 2 (Wireless Communication)

- Information Theory
- Noise
- Basedband
- Error detection
- Passband

Supplementary Notes:
Electromagnetics and Antennas (11 sessions)

- Fundamentals on Electromagnetics (2 sessions)
  - Electric and magnetic field: dielectric permittivity and permeability, electric charge, field and potential, electric current, Electric/Magnetic flux and flux density, Gauss's Law.
  - Maxwell Equations: Ampere's law at a point and current density, Power and Joule's Law, Faraday's Law, Divergence, Curl.
- Waves (3 sessions)
  - Time varying/time harmonic em fields, Uniform Plane Waves, wave impedance, phase and group velocity, wavelength.
  - Poynting vector of a uniform plane wave and Polarisation (linear, circular, elliptical)
  - Reflection and Transmission (normal and oblique incidence).
- Radiation - Fundamentals on Antennas (2 sessions)
  - Radiation Pattern, Power density and Intensity, Beamwidth
  - Directivity, Gain, realised gain, antenna efficiency, input impedance, effective area, antenna radiation efficiency
- Antennas (2 sessions) *
  - Linear antennas, Hertzian dipole, Small dipole, half-wavelength dipole,
  - Loop antennas, Finite length loop antenna, Magnetic dipole
- Antenna arrays (2 session) *
  - Antenna array fundamentals. Two-Element Array, N-Element array, Uniform amplitude and spacing, non-uniform amplitude and spacing
  - 2D uniform antenna array design, uniform rectangular array

Wireless Communication (11 sessions)

- Information Theory (2 sessions)
  - Information Source Model, Entropy, Source, and code efficiency.
  - Source coding techniques: Huffman coding, ZL (zip) coding.
- Noise (2 sessions)
  - Noise sources (focus on Thermal noise sources) and SNR
  - Equivalent noise sources temperature and noise Figure/Factor (including cascades systems).
- Basedband (4 sessions)
  - Modulation techniques (line codes): NRZ, RZ, Biphase, Miller
  - Probability of bit error in baseband signalling
  - Channel capacity, bandwidth efficiency, eye diagrams

    - Intersymbol interference (ISI)
- Error detection (1 sessions)
    - Code types: Parity check, Cyclic Redundancy Check
- Passband (2 sessions)
    - Modulation techniques (ASK, FSK, PSK)
    - High order (m-rmy) modulation techniques (QPSK, QAM)

Details for Lab exercises:

Part 1

- Lab 1: Use of the antenna toolbox in MATLAB on the design of antennas and antenna arrays

Part 2

- Lab 2: Use of Simulink in MATLAB to test the effect of noise on baseband digital signals.
- Lab 3: Use of Simulink in MATLAB to investigate the nature of binary FSK and PSK modulation in both time and frequency domains.

Details for the CW Part 1:

- Numerical problem assessing the understanding of Maxwell's equations
- Practical design problem of waves absorption in material (likes of Salisbury screen)
- Practical design problem of antenna array using any Numerical tool (NEC, Matlab) to develop AESA radar array or ILS antenna array

Learning Outcomes:

Part 1 (Electromagnetics and Antennas)

- Have a strong grasp of the fundamental concepts of electromagnetic theory, principles, and applications.
- Physical understanding of propagating waves.
- Understand fundamentals of electromagnetic radiation and antennas.
- Design and test linear and/or loop antennas.
- Design and test uniform planar antenna arrays.

Part 2 (Wireless Communication)

- Understand the fundamentals of Information Theory.
- Perform communications system Noise calculations.
- Understand the basic principles in Baseband communication.
- Implement selected source coding and error detection schemes.
- Select appropriate digital modulation schemes for given application demands and constraints.
- Understanding of basic building blocks for wave propagation in wireless communication.

Skills:

- Understand the physical behind electromagnetic fields and waves
- Analyse & design basic antennas and uniform antenna arrays
- Understand fundamentals of wireless communication
- Understand the operation of modern, digital communication systems
- Problem solving, troubleshooting, debugging and measurement skills through CW assignments and lab activities

ELE 2041 – Electronics and Circuits

Course Detail

Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Components: Lecture Required, Practical Required
Assessment: Coursework 15%, Exam 70%, Laboratory Project 15%
Pre-Requisites: None
Co-Requisites: None
Compulsory Element: None
Course Contents:
Part 1 (Circuits)

- System Equation
- Linear circuits
- Circuit Theorems and Methods of Circuit Analysis
  - Mesh analysis
  - Nodal analysis
  - Thévenin's theorem
- Two-port networks
  - Admittance parameters
  - Impedance parameters
  - Hybrid parameters
  - Transmission parameters
- Laplace transform in circuit analysis
- SPICE simulation software (LTspice, Qucs-spice)

Part 2 (Electronics)

- Linear Operational amplifiers: Basic operation, models, active Filters
- Non - Linear Operational amplifiers: oscillators and waveform generators
- Semiconductor diode: diode models, Zener Diodes, applications in DC power supplies, circuit analysis techniques, circuit design
- Bipolar transistor: internal current components, current gain, common configuration and basic equations, large/small signal model, bias circuits
- Bipolar transistor applications: Switching transistor, constant current source, regulated dc power supply, amplifiers, differential amplifier, frequency response of amplifiers
- FET transistors: small signal model, bias circuits, appreciation of differences between FET and bipolar transistor
- FET transistor applications: amplifiers including frequency response

Supplementary Notes: None
Learning Outcomes:
Part 1 (Circuits)

- Be able to apply Kirchhoff's current law and Kirchhoff's voltage law and Ohm's law to solve electric circuits including node and loop analysis
- Understand the concepts of linearity
- Know how to analyze electric circuits using the principle of supernode and supermesh
- Understand when and how to use a source transformation
- Know how to analyze electric circuits containing dependent sources
- Be able to calculate a Thévenin equivalent circuit for a linear circuit
- Know how to calculate admittance, impedance, hybrid, and transmission parameters for two-port networks
- Be able to convert between admittance, impedance, hybrid, and transmission parameters
- Understand the interconnection of two-port networks to form more complicated networks
- Know how to combine capacitors and inductors in series and parallel
- Know how to calculate impedance and admittance for our basic circuit elements: R, L, C
- Be able to combine impedances and admittances in series and parallel
- Know how to use the Laplace transform to analyze transient circuits

Part 2 (Electronics)

- Understand and apply semiconductor device models

- Produce equivalent circuits of operational amplifiers, diodes and transistors
- Apply linear circuit techniques such as Thévenin theorem, Kirchhoff's current law and potential divider rule, to semiconductor equivalent circuits
- Analyse and design analogue circuits containing components such as operational amplifiers, diodes and transistors geared towards specific applications
- Understand the real life specifications of semiconductor devices and circuits and how to produce designs within certain practical constraints
- Derive transfer function equations for semiconductor circuits including frequency response

Skills:

- Numeric
- Problem solving theoretical circuit designs
- Analyse & design analogue circuits using op-amps, diodes and transistors
- Understand the operation of semiconductor devices.
- Understand "real world" applications of electronic circuits
- Problem solving, troubleshooting, debugging and measurement skills through lab activities

STAGE 3

CSC 3001 - Formal Methods
Course Detail
Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Components: Lecture Required
Assessment: Assignment 30%, Paper 70%
Pre-Requisites: Recommended but not essential: CSC2059
Co-Requisites: None

Compulsory Element: An overall mark of at least 40% is required to pass the module.
Course Contents
A rigorous approach to software development. Logical foundations. Specification of data types. Implicit and direct specification of functions and operations. Reasoning about specifications, refinement, axiomatic semantics.
Supplementary Notes: None
Learning Outcomes: To present a scientific approach to the construction of software systems.
Skills: Precision and conciseness of expression. Rigour in thought.

CSC 3002 - Computer Science Project

Course Detail
Career: Undergraduate
Units: 40.00
Grading Basis: Graded
Course Components: Project Required
Assessment: Project 100%
Pre-Requisites: None
Co-Requisites: None
Compulsory Element: Attendance at supervisory meetings; project submission.
Course Contents
A project requiring the construction of a software system (specification, user interface design, system design and realization of system design).
Supplementary Notes: None
Learning Outcomes: On completion of this module, the successful student will have achieved the following learning outcomes, commensurate with module classification:

- Demonstrate competency in the techniques necessary for a rigorous and disciplined approach to software construction. As part of this students should demonstrate:
  - an ability to analyse a problem area using a range of sources and to synthesise the relevant information into a proposed solution approach;
  - innovation, creativity as well as practical and analytical skills in providing a software solution to a problem area;
  - competency in implementing a substantial and robust software product and to self-manage the project;
  - ability in critical appraisal of their own work in relation to a wider context; and
  - ability in documentation and report writing.

Skills:
KNOWLEDGE & UNDERSTANDING: Understand project management techniques and requirement analysis techniques.
INTELLECTUAL: Problem solving skills using IT skills and system design skills.
PRACTICAL: Selection and application of appropriate IT tools, application of system design and implementation techniques, delivery of a system on time, reliably and to specification.

CSC 3021 - Concurrent Programming

Course Detail
Career: Undergraduate
Units: 20.00
Grading Basis: Graded:
Course Components: Lecture Required, Practical Required
Assessment: Coursework 100%
Pre-Requisites: CSC2059 **OR** CSC2058
Co-Requisites: None
Compulsory Element: None
Course Contents
Concurrent Programming Abstraction and Java Threads, the Mutual Exclusion Problem, Semaphores, Models of Concurrency, Deadlock, Safety and Liveness Properties. Notions are exemplified through a

selection of concurrent objects such as Linked Lists, Queues and Hash Maps. Principles of graph analytics, experimental performance evaluation, application of concurrent programming to graph analytics.
Supplementary Notes: Prior knowledge of Java is mandatory
Learning Outcomes: To understand the problems that are specific to concurrent programs and the means by which such problems can be avoided or overcome.
Skills: To model and to reason rigorously about the properties of concurrent programs; to analyse and construct concurrent programs in Java; to quantitatively analyse the performance of concurrent programs.

CSC 3023 - BIT Project

Course Detail
Career: Undergraduate
Units: 40.00
Grading Basis: Graded
Course Components: Lecture Required
Assessment: Project 100%
Pre-Requisites: None
Co-Requisites: None
Compulsory Element: Individual Project, group participation and attendance at supervisory meetings.
Course Contents

- A project requiring the construction of an information technology based solution to a business-related problem. To include:
  - Software Design: Agile software design (iterative development, agile development principles), User Experience design.
  - User Acceptance Testing.
  - Web app development that could be deployed to mobile/tablet.

Supplementary Notes: None
Learning Outcomes: Be able to

- Apply appropriate commercial and economic strategies to produce an IT system for a business-related problem through the use and maintenance of information systems.
- Select and assess user, task and technical requirements and tests for a given application.
- Design and develop appropriate user interfaces tailored to a domain specific application for a specific user population.
- Design and develop a web-based front-end and a databases back-end in fulfilment of user requirements.
- Demonstrate a range of project management skills including those relating to the management of cost, quality, human-resource, communication and risk through the development of a project plan and the use of strategic planning.

Skills:
KNOWLEDGE & UNDERSTANDING: Understand project management techniques and requirement analysis techniques.
INTELLECTUAL: Problem solving skills using IT skills and system design skills.
PRACTICAL: Selection and application of appropriate IT tools, application of system design and implementation techniques, delivery of a system on time, reliably and to specification.

CSC 3031 – Software Design Principles and Patterns, Practice and Innovation

Course Detail
Career: Undergraduate
Units: 20.00
Grading Basis: Graded

Course Components: Lecture Required, Practical Required
Assessment: Coursework 100%
Pre-Requisites: None
Co-Requisites: None
Compulsory Element: None
Course Contents
Underlying Principles of Good Software Design. Creational patterns; Structural patterns; Behavioural patterns; Architectural Patterns. Commercialisation of software products, Entrepreneurship and Innovation, Legal Social and Ethical considerations.
Supplementary Notes: In developing software, no matter what domain or particular problem area, there are likely to be well-established principles that will assist in developing a solution and even a high chance that a similar or analogous solution already exists. This is true especially for object-oriented design where software design patterns and their underlying principles are well-documented. Knowing when and where to apply which solution is crucial to long-term success. The same is true from a commercial perspective. Those developing innovative software need to be aware of how to realise those innovations and how to develop ideas to make a commercial and/or social impact. At the same time, regulatory and ethical aspects must be addressed, if innovative software is to be viable and acceptable.
Learning Outcomes: On completion of this module, the successful student will have achieved the following learning outcomes, commensurate with module classification:

- Understand and be able to explain with examples the basic principles of good OO design;
- Demonstrate the capability to design and implement a range of well-known software design patterns.
- Be able to document a given software design pattern;
- Be able to choose between software design patterns;
- Know the steps in bringing a software product to market
- Appreciate the Legal, social and ethical considerations in delivering software.

Skills:
None

CSC 3032 - Software Engineering Project

Course Detail
Career: Undergraduate
Units: 40.00
Grading Basis: Graded
Course Components: Project Required
Assessment: Project 100%
Pre-Requisites: None
Co-Requisites: CSC3045
Compulsory Element: Attendance at supervisory meetings and project submission are compulsory elements.
Course Contents
The module requires team-based work aimed to the construction of a new software system or to contribute to an existing codebase with each team member responsible for a key component of the resulting codebase (e.g., a functionality, an API) and process (e.g., requirements analysis, evaluation). Students leverage on the skills and knowledge that they have acquired and that they will be acquiring from other modules and, if applicable, from their professional experience. Students will further their understanding of core SE principles by demonstrating their ability to put them into practice across the entire software life cycle, and they will be responsible for the promotion and demonstration of the completed work and software system to peers, academic staff, external non-academic stakeholders, and representatives of the computing profession.
GUIDING PRINCIPLES
The module is run according to the following guiding principles:

1. A focus towards on-demand, self-directed learning that favours hands-on practice.
2. A cohort approach in which teams work together in a mutually supportive environment.

3. An emphasis on experimentation where students gain hands-on knowledge of different and often competing software design & development choices and learn how to choose between them.
4. Close collaboration with academic staff and external stakeholders as mentors rather than instructors.

Supplementary Notes: Attendance at supervisory meetings and project submission are compulsory elements.

Learning Outcomes

On completion of this module, the successful student will have achieved the following learning outcomes, commensurate with module classification:

1. Demonstrate competency in the techniques for a disciplined and systematic approach to software practice across the entire software life cycle.
2. Demonstrate ability to research in a specific application area and use research outcomes to devise novel and creative approaches to solutions.
3. Practice independent learning and show ability to address problems in a manner that demonstrates critical thinking and responsible reasoning underpinning decisions.
4. Show competency in a range of professional skills including those relating to project planning, resource allocation, and risk management.
5. Demonstrate ability to anticipate, identify, and assess the wider impact (e.g. societal, environmental) of the proposed system through independent research and teamwork.
6. Demonstrate an ability to elicit and respond to feedback from end-users, stakeholders, and other experts to gauge the degree to which the project has delivered, or is likely to deliver in the longer term, the benefits (e.g., social, economic, environmental) that were anticipated.
7. Demonstrate ability to work effectively and responsibly in a team environment
8. Develop practice in explaining, documenting, and promoting the system developed.
9. Demonstrate attainment of QCA Keystage 4 "Working with others" key skills.
10. Demonstrate attainment of QCA Keystage 4 "Communication" key skills.

Skills: The module provides an opportunity to exercise aspects of the following QCA Key Skills (at proficiency Level 4): Communication, ICT, Improving Own Learning and Performance, Problem Solving, Working with others. Additionally, the module provides an opportunity for students to develop the critical faculties needed to assess the societal, commercial and economic implications of the software systems that they are developing and to adjust their development plans accordingly.

CSC 3045 – Team-Based Software Innovation (Team Based Computing Project)

Course Detail

Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Components: Lecture Required, Practical Required
Assessment: Project 100%
Pre-Requisites: None
Co-Requisites: None
Compulsory Element: Project

Course Contents

"Ambiguous problem situations (‘wicked problems’); design thinking and innovation; design thinking practice and agile software development practices; appropriate software development technologies; project management; collaboration and teams; remote and face-to-face collaboration"

Supplementary Notes: None

Learning Outcomes

- Understand the principles of agile software innovation
- Understand a range of practices that agile, software-innovation teams can apply
- Understand the properties of, and the impact of, ambiguous problem situations, e.g., wicked problems
- Develop suitable interim and final software prototypes using agile practices and software innovation practices
- Demonstrate proficiency in using a range of contemporary tools and techniques

- Understand the range of factors that can influence the success of team-based software innovation
- Complete a project which demonstrates strong project and team skills.

Skills

This module provides an opportunity to exercise aspects of the following Key Skills (at QCA proficiency Level 4); ICT, Improving Own Learning and Performance, Problem Solving

CSC 3047 - CIT Project (IT Enterprise Project)

Course Detail

Career: Undergraduate
Units: 40.00
Grading Basis: Graded
Course Components: Lecture Required
Assessment: Project 100%
Pre-Requisites: None
Co-Requisites: None
Compulsory Element: Individual Project, group participation and attendance at supervisory meetings.

Course Contents

- A project requiring the construction of an information technology based solution to a user-focused problem. To include:
  - Software Design: Agile software design (iterative development, agile development principles), User Experience design.
  - User Acceptance Testing.
  - Web app development that could be deployed to mobile/tablet.

Supplementary Notes: None
Learning Outcomes: Be able to:

- Apply appropriate user experience design, commercial and economic strategies to produce an IT system for a user-focused problem which can include the use and maintenance of information systems.
- Select and assess user, task and technical requirements and tests for a given application.
- Design and develop appropriate user interfaces tailored to a domain specific application for a specific user population.
- Design and develop a web-based front-end and a databases back-end in fulfilment of user requirements.
- Demonstrate a range of project management skills including those relating to the management of cost, quality, human-resource, communication and risk through the development of a project plan and the use of strategic planning.

Skills:

KNOWLEDGE & UNDERSTANDING: Understand project management techniques and requirement analysis techniques.
INTELLECTUAL: Problem solving skills using IT skills and system design skills.
PRACTICAL: Selection and application of appropriate IT tools, application of system design and implementation techniques, delivery of a system on time, reliably and to specification.

CSC 3056 - Software Testing

Course Detail

Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Components: Advisory Required, Lecture Required, Practical Required, Project, Available for Exchange /Study Abroad
Assessment: Paper 100%

Pre-Requisites: Java/ Object-oriented (OO) programming
Co-Requisites: None
Compulsory Element: None
Course Contents:
Concepts, techniques, and tools in software testing including: Unit testing, integration and system testing, acceptance testing, GUI testing, test coverage analysis, automated testing, test tools, test management, test organisation, test planning, test maturity and career paths in Software Testing.
Supplementary Notes
None
Learning Outcomes
On completion of this module, the successful student will have achieved the following learning outcomes, commensurate with module classification:

- Be able to understand and apply fundamental testing principles and techniques.
- Be able to develop an appropriate test plan alongside a relevant set of tests for a given piece of software against a set of defined test goals.
- Be able to efficiently organise, execute, report and evaluate a given test plan against a piece of software.
- Be able to effectively employ a range of test automation tools.

Skills
Understanding and applying various software testing concepts, techniques, and tools.

CSC 3059 - Malware Analysis

Course Detail
Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Components: Lecture Required, Practical Required
Assessment: Paper 40%, Practical 60%
Pre-Requisites: None
Co-Requisites: None
Compulsory Element: None
Course Contents

- Cyber Security Overview
- Malware Analysis in Virtual Machines
- Basic dynamic analysis
- X86 Disassembly
- IDA Pro
- Recognising C Code Constructs in Assembly
- Malware Types
- Analyzing Malicious Window Programs
- Covert Malware Launching
- Malware Behaviour and Signatures
- Machine learning for malware detection

Supplementary Notes: None
Learning Outcomes:
Students should be able to:

- Ability to perform basic and advanced static analysis
- Ability to perform basic dynamic analysis
- Understand the different types of malware and understand their behaviour
- Understand how automated malware detection works

Skills: Problem analysis, Problem solving. Rigour in thought. Ability to work individually or as part of a team. Demonstrate increased communication, library, research, time management and organisational skills.

CSC 3062 - Data Analysis and Visualisation

Course Detail
Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Components: Lecture Required, Practical Required
Assessment: Coursework 100%
Pre-Requisites: None
Co-Requisites: None
Compulsory Element: None
Course Contents

- How Data Analytics is used in industry and research
- Obtaining data
- Cleaning and converting data into a form to make it suitable for analysis and visualisation
- Use of existing tools to visualise data
- Use of existing tools to identify statistical patterns
- Formulating and testing theories about data
- Communicating data analytic discoveries effectively

Supplementary Notes: Project is developed in stages throughout the module (not submitted in stages)
Learning Outcomes: Be able to:

- Explain how data analytics is used in industry and research.
- Demonstrate the ability to obtain, process and clean data for analysis.
- Use existing tools to visualise and analyse data.
- Formulate and test theories about data.
- Communicate discoveries effectively.

Skills: Creativity in obtaining useful data. Ability to use techniques to clean and process data. Ability to use existing tools for analysis and visualisation of data. Creativity and reasoning skills required to formulate theories about data and to evaluate those theories using statistical analysis of the data. Communicating theories about data in a clear way. Demonstrating patterns in data in a convincing way.

CSC 3063 - Secure Software Development

Course Detail
Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Components: Lecture Required, Practical Required
Assessment: Assignment 40%, Practical 1 30%, Practical 2 30%
Pre-Requisites: None
Co-Requisites: None
Compulsory Element: None
Course Contents
Lectures:

- Introduction to the threat landscape
  - Attack surface and vectors
  - Attacker's perspective (Bad actors)
- Software assurance initiatives and standards
  - The need for software assurance (famous disaster)
  - OWASP, CWE, SANS, etc.
- Secure software development lifecycle
  - Examine the different approaches to software management
- Security issues, risks and risk management
  - Types of attacks/vulnerabilities
  - Roles and Responsibilities
  - Vulnerability management (CVE)

- Requirements specification and threat modelling
  - Identifying risks
  - Misuse and Abuse Cases
  - Model and manage risks
- Secure architecture and design
  - Asset Protection
  - Authentication, Authorisation
  - Risk management
  - Code deployment (signing)
- Secure coding, principles and practice
  - Secure Coding standards
  - Examine different programming languages
- Security analysis and testing
  - Testing principles
  - Black/white Box, Unit testing, Integration and Regression testing
  - Testability of software (third party etc.)
- Development and code analysis tools
  - Types of code analysis tools
  - Scanner and penetration tools

Coursework:

- Implement an SQL filter to detect attack strings
- Secure Code Review Report

Practical Labs:

- Investigate three forms of injection attacks- Implement three attacks on a Weak-Server and write an evaluation report.
- Scanner Analysis tools – Perform a security risk assessment on a web application using appropriate scanner tools.
- Code analysis tools – Using both static and dynamic code analysis, evaluate a software program for vulnerabilities.

Supplementary Notes: None

Learning Outcomes:

A successful student will be able to:

- Explain industry's approach to software assurance
- Manage and implement software assurance processes
- Understand and critically assess security requirements
- Identify software risks and vulnerabilities
- Implement secure coding standards
- Demonstrate the use of software vulnerability verification tools

Skills:

Successful participation in this module will enable students to develop skills in the following areas:

- Manage one’s own learning and development including time management and organisational skills
- Good cyber security practice in the specification, design, implementation, evaluation and maintenance of security solutions.
  - Adversarial thinking, threat landscape and attack vector evaluation.
  - Perform risk assessment and identify countermeasures.
  - Understanding impact and consequences
  - Design and development secure software programs
  - Software security testing and vulnerability analysis

CSC 3064 - Network Security

Course Detail

Career: Undergraduate

Units: 20.00

Grading Basis: Graded

Course Components: Lecture Required, Practical Required

Assessment: Coursework 100%

Pre-Requisites: None
Co-Requisites: None
Compulsory Element: None
Course Contents:
Introduction to Network Security:

- Key concepts & principles
- Attack Types, Threats, vulnerabilities in Internet Protocols.
- Firewalls, Access Control and Traffic Filtering
- Intrusion Detection and Prevention Systems
- Secure Network Architecture
- Internet Security Protocols

Supplementary Notes: None
Learning Outcomes: A successful student will:

- Know and understand the administration of network security
- Know and understand the technologies involved in the design and deployment of secure networks
- Be able to demonstrate the use of tools for network security analysis, Firewalls etc

Skills: This module provides an opportunity to exercise aspects of the following QCA Key Skills (at proficiency Level 4): Communication, ICT, Improving Own Learning and Performance, and Problem Solving

CSC 3065 - Cloud Computing

Course Detail
Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Components: Lecture Required, Practical Required
Assessment: Continual Assessment 100%
Pre-Requisites: None
Co-Requisites: None
Compulsory Element: Students must complete all elements of module assessment and attain an overall pass.
Course Contents
The Cloud Computing module will provide an opportunity for you to learn about and explore a wide range of concepts, technologies, providers, and applications of cloud computing. Initially the module will focus on concepts including how we design, deploy, and manage cloud software and infrastructure to ensure both high availability and elastic scaling (being able to go from thousands of users to millions of users seamlessly). You will learn in detail how software can be developed in such a way as to easily allow (or not) cloud deployment including concepts of functional and stateless programming. After covering general concepts and generic technologies such as containerisation for micro-services, virtualisation, and devops pipelines, the module moves on to look at specific modern cloud providers such as AWS, GCP, and Azure. You will examine the differences between these platforms, learn how to deploy to them, and also gain experience of Meta tools which are platform-agnostic and can be used to specify and manage cloud estates covering multiple providers.
Supplementary Notes: None
Learning Outcomes
On completion of this module, students will be able to:

- Demonstrate knowledge, understanding and the application of:
  - Core cloud concepts including data synchronisation, performance management, security, and infrastructure design
  - Virtual machines and virtualisation stacks
  - Container technology including coordinated container swarms and approaches
  - Elastic scalable computing with automatic adjustment to load conditions
- Demonstrate knowledge, understanding and the application of the principles and application of appropriate software development considerations to ensure developed software is cloud-deployable

- Demonstrate knowledge and understanding of the principles of functional and stateless programming
- Demonstrate knowledge and understanding of the principles of modern devops pipelines including automated infrastructure, continuous integration, continuous deployment, and monitoring
- Demonstrate knowledge and understanding and the application of common widely used cloud hosting platforms and management tools

Skills: None

CSC 3066 Deep Learning

Course Detail

Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Components: Lecture Required, Practical Required
Assessment: Assignment 1 30%, Assignment 2 30%, Paper 40%
Pre-Requisites: CSC3067 Video Analytics and Machine Learning
Co-Requisites: None
Compulsory Element: None

Course Contents

- Overview of generic machine learning pipelines
- Deep learning
  - Feedforward neural networks
  - Regularisation for deep learning
  - Optimisation for training deep models
  - Convolutional networks
  - Auto-encoders
  - Recurrent Networks
  - Siamese Neural Network
- Evolving learned models
  - Active Learning
  - Transfer Learning
  - Incremental Learning
- Applications of deep learning

Supplementary Notes

None

Learning Outcomes

Be able to:

- Explain when and how machine learning is useful in industry, public institutions and research.
- Know and apply state-of-art deep learning techniques.
- Demonstrate the ability to understand and describe the underlying mathematical framework behind these operations.
- Design and develop original deep learning pipelines applied to a variety of problems
- Formulate and evaluate novel hypothesis
- Analyse an application problem, considering its suitability for applying deep learning, and propose a sensible solution
- Evaluate the performance of proposed deep learning solutions through rigorous experimentation
- Analyse quantitative results and use them to refine initial solutions
- Communicate findings effectively and in a convincing manner based on data, and compare proposed systems against existing state-of-art solutions

Skills

Problem solving. Self and independent learning. Research. Working with others and organisational skills. Critical analysis. Quantitative evaluation. Mathematical and logical thinking.

CSC 3067 Video Analytics and Machine Learning

Course Detail

Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Components: Lecture Required, Practical Required
Assessment: Class Test 1 20%, Class Test 2 40%, Project 40%
Pre-Requisites: Normally CSC2062
Co-Requisites: None
Compulsory Element: Project

Course Contents

- Overview of imaging and video systems and generic machine learning pipelines
- Pattern recognition problems: Verification, detection and identification
- Data pre-processing:
  - Image enhancement: Normalisation. Point Operations, Brightness and contrast.
  - Filtering and Noise reduction. Convolution
- Classification
  - Support Vector Machines (SVM).
  - Boosting and ensemble of classifiers
  - RF
  - Neural networks.
  - Deep Learning.
- Vision-specific Feature extraction:
  - Simple features
  - Gradients and Edge extraction
  - Colour Extraction and colour histograms
  - SIFT
  - Histogram of Gradients HoG
- Unsupervised learning:
  - Clustering and Bag of Words for vision
  - Self-organised maps
- Segmentation, tracking and post processing
  - Brightness segmentation
  - Motion detection; Background modelling and subtraction; Optical Flow
  - Template Matching
  - Tracking: Kalman Filter, Particle Filter and tracking by detection
  - Introduction to time series analysis
- Dimensionality reduction techniques and latent spaces.
  - The curse of dimensionality
  - Principal component analysis (PCA).
  - Linear discriminant analysis (LDA).
- Introduction to Deep Learning
- GPU acceleration for video processing.
- Applications:
  - Video Surveillance
  - Cyber-physical security
  - Medical imaging
  - Secure corridors.
  - Pose estimation.
  - Biometrics
  - Face detection
  - Human behaviour analysis.

Supplementary Notes

None

Learning Outcomes
Be able to:

- Explain when and how machine learning and computer vision is useful in industry, public institutions, and research.
- Know and apply a range of basic computer vision and machine learning techniques.
- Demonstrate the ability to understand and describe the underlying mathematical framework behind these operations.
- Design and develop machine learning pipelines applied to computer vision applications
- Formulate and evaluate hypothesis
- Evaluate the performance of proposed machine learning solutions through rigorous experimentation
- Analyse quantitative results and use them to refine initial solutions
- Communicate finding effectively and in a convincing manner based on data, and compare proposed systems against existing solutions

Skills
Problem solving. Self and independent learning. Research. Working with others and organisational skills. Critical analysis. Quantitative evaluation. Mathematical and logical thinking.

MUS3006 – Digital Audio Effects

Course Detail
Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Components: Lecture Required, Advisory Required
Assessment: Assignment 1 30%, Assignment 2 30%, Project 40%
Pre-Requisites: ELE2020 Signals and Communication
Co-Requisites: None
Compulsory Element: None
Course Contents
This module will introduce the basics of digital audio processing and how to achieve practical sound effect implementations. In the first half of the module, students learn how standard processing units such as filters, delays, modulators, compressors, and limiters can be employed to generate a range of classical effects. This involves two individual assignments: the first one is focused on the understanding of theory, concepts, and methods and in the second one the students design, implement, and demonstrate an effect chain.
In the second part, students undertake an individual project in which they individually study a more advanced method of approach within one of the following more areas; analogue effects emulation, physical modelling, spatial audio, and spectral processing.
Supplementary Notes: None
Learning Outcomes:
On completion of this module, a student will have achieved the following learning outcomes:

- Comprehensive understanding of a wide range signal processing elements used in digital audio effects, including knowledge and appreciation of different approaches and paradigms
- Understanding of the way audio effects are applied, including typical source signals and parameter control
- Critically evaluate audio processing algorithms in terms of effectiveness and computational demand.

Skills:
Successful participation in this module will enable students to develop skills in the following areas:

- Study digital audio effects independently, from a variety of sources and by a variety of techniques.
- Design and Matlab implementation of audio effect algorithms
- Manage one's own learning and development including time management and organisational skills.

- Articulate and effectively communicate the design and technological rationale for a given audio effect model through appropriate technical reports and presentations

ECS 3003 - Connected Health
Course Detail
Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Components: Lecture Required,
Assessment: Coursework 30%, Paper 70%
Pre-Requisites: None
Co-Requisites: None
Compulsory Element: None
Course Contents
Connected Health is a model for healthcare delivery that uses technology to provide healthcare remotely. It is a rapidly evolving societal challenge. Innovative Information and Communication Technology is core to its success. This module examines the connected health concept with a focus on the enabling technology.

- The evolution of Connected Health; Tele-health and medicine, Current trends and challenges.
- How fundamental electronics can be used to transduce medical markers from the human body.
- Personal health data networks (IEEE 11073); standards and regulation; Medical device approval study (MHRA/FDA).
- Electronic patient records, Digital Health Records, Data management (security, privacy). Data processing and analysis.
- Medical electronics and sensors; sensor analysis and design; sensor circuit theory and analysis; Invasive wireless implant sensors.
- Body sensors and personal area networks; Physiological measurement and monitoring; wireless sensor networks in healthcare applications.
- Biologically inspired sensing and data harvesting. For future applications.

The module is structured into four main topics: Topic 1: Evolution of Connected Health; Topic 2 Medical Biosignals and Sensing; Topic 3: Standards & Regulations inc: Industrial Case Study; Topic 4 Wireless Healthcare Technologies.
Supplementary Notes: None
Learning Outcomes: After the completion of this module you will be able to:

- Describe the recent evolution of connected health technologies.
- Understand the electronics and software requirements for selected connected health applications.
- Describe specific point of care sensor technologies and their role in physiological monitoring.
- Practical understanding of the different roles of electronic sensor devices
- Describe the need for standards and regulations in connected health.
- Design and analyse different electronic circuits for the analysis of raw medical biosignals
- Understand the communications and networking of wireless connected health devices

Skills:

- Problem solving
- Numeric
- Improving Own Learning and Performance
- Information and Communication Technology

ELE 3001 - Project 3
Course Detail
Career: Undergraduate
Units: 40.00
Grading Basis: Graded
Course Components: Practical Required
Assessment: Continual Assessment 50%, Report 50%

Pre-Requisites: 5 x Level 2 modules
Co-Requisites: None
Compulsory Element: None
Course Contents
The project is normally an investigation or design study of various branches of electrical and electronic engineering. The project originators typically endeavour to ensure an element of design, manufacture and test in the project specification, even if the project is software-based. There are, of necessity, many variations on this theme.
Supplementary Notes: None
Learning Outcomes: To develop ability to conduct a substantial project over an extended period, perceive the nature of engineering problems or product specifications; to acquire and develop necessary skills and to plan and execute a suitable programme of work, including a final report.
Skills: Ability to apply general principles and design or analytical techniques to the solution of engineering problems. Such solutions may require investigative, practical or design skills or a combination of the three. Originality is encouraged.

ELE 3037 - High Frequency System Techniques

Course Detail
Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Components: Lecture Required,
Assessment: Coursework 30%, Paper 70%
Pre-Requisites: None
Co-Requisites: None
Compulsory Element: None
Course Contents
Lectures:

- Noise Theory: Noise mechanisms, noise definitions; noise figure, noise temperature, Friis formulae, minimum detectable signal.
- Antenna and Front-End Techniques: Basic array theory, front-end architectures.
- Non Linear Circuits and Systems Qualification: intermodulation products, mixer fundamentals, power compression, dynamic range.
- Direct Broadcast Satellite (DBS) System: Geostationary orbit, EIRP, free space loss, received power density, Earth station design, G/T; design example, roof top Earth station for DBS TV reception.
- Transmission Line (TL) Theory: High frequency circuit building blocks and component design, wave propagation modes, incremental TL Line model and analysis, terminated TL, performance metrics and figure of merit definitions.
- Microwave & RF Circuit Design Techniques: Transmission line topologies, fabrication and selection of materials, concept of effective permittivity, performance optimisation of microstrip TL, stubs and couplers, graphical design methods using the Smith Chart and the Hammerstad equivalent circuit technique, design example, a low pass microwave filter.
- Impedance Matching Techniques: Design consideration based on Q factor, conjugate matching, L and T circuit design, distributed elements, the microstrip stub, single and double stub matching design using the Smith chart.
- Two Port Parameters and Amplifier Design: Scattering parameters, cascaded networks and T parameters, introduction to microwave measurements, amplifier gain definitions, signal flow analysis, Mason's non-touching rule, unilateral amplifier design.

Coursework:

- Design of a basic communications system: Top level system design for satellite TV reception.
- Two Stage Microwave Amplifier Design: The design of three different distributed impedance matching circuits using Smith charts, and the creation of the physical layout of the microstrip components using a graphical technique.

Supplementary Notes: None

Learning Outcomes:

- Have a strong grasp of the fundamental concepts and electronics principles needed for high frequency electronics system and circuit design.
- Understand the basic concepts used in the generic design of modern wireless communications systems.
- Physical understanding of the techniques that are used to design, fabricate and measure circuit components operating in the GHz frequency band.
- Interpretation and application of design figures of merit as specified on component and sub-assembly manufacturer data sheets.
- Experience of making an overall top level communications systems design to a constrained specification with particular reference to a microwave system.
- Interpretation of manufacturers microwave amplifier data sheets and extraction of relevant electrical performance metrics.
- Experience of impedance matching circuit design using Smith charts, and concepts used for performance optimisation of distributed circuit matching elements.
- Practical experience in obtaining the geometrical dimensions and creating the physical layout of microstrip components and circuits.

Skills:

- To engender the philosophy of structured top-level communication system design.
- To be able to apply theoretical concepts in an iterative fashion in order to create a paper design to a given specification.
- Understand transmission line theory and the use of a design tool based on the Smith chart for solving impedance matching circuit problems.
- Use of a graphical technique to create the physical layout of printed microwave circuits.
- Knowledge of key electrical and physical properties of microwave substrate materials, and design considerations for the construction of circuits based on different topologies.
- Measuring components operating in the GHz frequency band.

ELE 3039 - Electrical Power and Energy

Course Detail
Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Components: Lecture Required
Assessment: Coursework 30%, Paper 70%
Pre-Requisites: ELE2019 Electrical Power Engineering 2
Co-Requisites: None
Compulsory Element: None
Course Contents

- Modelling of a Synchronous Generator and Introduction to Parks Transform
- Steady-State Operation (Phasor Diagrams)
- Dynamic Operation (modelling dynamics and introduction to AVR)
- System Stability and Control (linearized model, and design of PSS)
- Design of AVR (Pure control Theory)
- Transmission line parameters form first principles
- Overcurrent protection
- Fault analysis & fault level
- Embedded Generation
- DC Transmission

Supplementary Notes: None
Learning Outcomes:

- Familiarisation with highly relevant and classical problems inherent in power systems and power plant operation
- Grasp the analytical tools available for advanced study and modelling of these problem areas
- Gain understanding of how to design optimal control strategies

- Use of commercial software Matlab /Simulink or Power Factory DigSilent
- An understanding of the effects of stranding and bundling of overhead transmission lines
- Understand the principles of overcurrent protection
- Understand the types, reasons for and issues associated with distributed generation
- An understanding of the relative merits of AC and DC transmission and typical applications

Skills:

- Numeric
- Problem solving
- Carry out steady state and dynamic analysis of power system
- Design optimal automatic voltage control
- Carry out simulation based design and stability analysis using Matlab /Simulink or Power Factory DigSilent software
- An ability to calculate overhead transmission line parameters from first principles
- Co-ordinate overcurrent, time and direction protection
- Calculate fault level and fault current.

ELE 3040 - Networks and Communications Protocols

Course Detail
Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Components: Lecture Required
Assessment: Class Test 20%, Coursework 20%, Paper 60%
Pre-Requisites: None
Co-Requisites: None
Compulsory Element: Coursework, Examination
Course Contents:
Lectures/Practicals:

- Overview of OSI layers
- Error detection and correction, Cyclic Redundancy Checking
- Forward error control, Viterbi coding/decoding
- Layer 2 principles: ARQ schemes (Idle RQ, Continuous RQ, link utilisation)
- Queuing theory principles (Latency, throughout, round-trip time, utilisation, single-server queues, multi-server-queues)
- MAC Layer (TDMA, OFDMA, CDMA, ALOHA, Carrier Sense Multiple Access)
- TCP/IP (Congestion control)
- Principles of physical layer. PHY aspects of cellular and mobile radio systems (Frequency reuse, Interference)
- High spectrally-efficient techniques for cellular systems (DSSS, Frequency-Hopping)

Coursework - Design Exercise:

- Fading phenomena in mobile communication systems using MATLAB
- Calculation of link margin and path-loss for different frequencies and environments
- Emulation of fading effects in MATLAB

Supplementary Notes: None
Learning Outcomes:

- Have a strong grasp on the fundamental concepts of networks and communication protocols.
- Understand the concepts of error detection and control
- Understand the principles of queuing theory and its applications on network protocols
- Calculate the average throughout, latency and utilisation of single and multi-server queues
- Describe the principles of the MAC layer and technologies associated with it
- Describe the operation of TCP/IP protocols
- Understand the fundamental concepts associated with the operation of mobile networks
- Practical understanding of how mobile communication systems work
- Determine the performance limits of mobile networks in MATLAB
- Simulate fading distributions in MATLAB

Skills:

- Assimilation of error correction and control techniques, OSI layers, protocols of communications and networks, queuing theory
- Ability to solve mathematical and conceptual questions individually
- Ability to meet specific deadlines
- Ability to simulate mobile systems in MATLAB
- Presentation of technical engineering information clearly and concisely in written form

ELE 3041 - Signal Processing and Communications

Course Detail
Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Components: Lecture Required
Assessment: Class Test 15%, Coursework 15%, Paper 70%
Pre-Requisites: ELE2020
Co-Requisites: None
Compulsory Element: None
Course Contents

- Discrete-time (DT) signals.
- Fourier analysis
- Discrete linear filters and adaptive filtering
- Laplace transform
- Stochastic signal processing and multipath fading channels
- Digital modulation and demodulation
- Channel coding
- OFDM
- Using signal processing to analyse the performance of communications systems

Supplementary Notes: None
Learning Outcomes:
After the completion of this module you will be able to:

- Have a strong grasp on the fundamental concepts and techniques pertaining to signals and communications systems, with an emphasis on the discrete-time domain, for further study in communications and signal processing.
- Design specific signal processing system models and algorithms.
- Perform statistical analysis and inferences on random signals
- Familiar with Matlab software in the simulation of DTFT and wireless communications systems

Skills:

- Numeric analysis
- System design and problem solving
- How to construct and analyse discrete- time models

ELE 3042 - Control Systems Engineering

Course Detail
Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Components: Lecture Required
Assessment: Coursework 15%, Paper 70%, Project 15%
Pre-Requisites: ELE 2024 or ELE2038
Co-Requisites: None
Compulsory Element: Design Project
Course Contents
Lectures:

- PRELIMINARIES:
  - Feedback control, poles and zeros, time domain specifications, Routh stability, discretisation, sampling time and resolution, analogue vs. digital control, s-plane and z-plane.
- CONTROLLER DESIGN
  - ROOT LOCUS DESIGN: Evans rules, compensator design, applications
  - FREQUENCY DOMAIN DESIGN: Bode plots, compensator design, applications
  - PID CONTROL (analogue and discrete): Zieglar-Nichols tuning method, applications
  - DIRECT DESIGN METHOD, discrete-time design, Method of Ragazzini
  - FREQUENCY RESPONSE BASED DESIGN, Bode plots, w-plane, applications
- IMPLEMENTATION ISSUES:
  - Digital simulation, hardware/software limitations, practical issues (aliasing, missing or corrupt data, chattering and deadbands)
- MATLAB and Simulink tutorials for computer assisted control system design (CACSD).

Design project:

- Lego Mindstorms-based modelling and control of a physical system
- Design and implement a control system on the Mindstorms-based physical system based on given specifications such as overshoot, settling time etc.
- Demonstration and presentation of the final design.

Supplementary Notes: None

Learning Outcomes:

General:

After the completion of this module you will be able to:

- Understand classical (analogue) control systems.
- Understand computer-based (digital) feedback control methods.
- Analyse and design simple feedback control systems to meet given performance specifications.
- Gain a good understanding of implementation issues.

Design Project/Laboratories:

- Practical understanding of modelling and controller design of a physical system.
- Importance of desired specifications.
- Practical understanding of software implementation using Matlab/Simulink.
- Hands-on experience of designing and implementing a real-time control system with application to robotics.

Skills:

General:

- Understanding of analogue and digital feedback control
- Problem solving
- Use of MATLAB software tools
- Importance of practical issues in converting theory into practice

Design project:

- Implementation and testing of control systems with application to Robotics
- Simulation programming
- Sensor measurements and use of sensors
- Use of control engineering principles to develop working solutions
- Presentation of technical engineering information clearly and concisely in oral and written form

ELE 3043 - Engineering Entrepreneurship

Course Detail

Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Components: Lecture Required
Assessment: Critical Review 20%, Presentation 30%, Report 50%
Pre-Requisites: Stage 2 Professional Engineering and Innovation
Co-Requisites: None

Compulsory Element: None
Course Contents
Lectures: Introduction to enterprise; student example pitches; overview of startup process; Intellectual property overview; funding opportunities; business consultancy approaches; importance of branding.
Self-working:

- Product development: derivation of product; creation of product specification; ethical and standards consideration.
- Business development: team development; product development; marketing approaches; financial planning.

Supplementary Notes: None
Learning Outcomes
General:

- Report writing.
- Business presentation.
- Assimilation of business practices.
- Generation of product.

Specific:

- Ability to pitch business concept.

Skills:

- Presentational skills.
- Development of business acumen.
- Business plan creation.
- Team-working.
- Self-assessment.
- Creativity.

ELE 3044 - Engineering Entrepreneurship

Course Detail
Career: Undergraduate
Units: 40.00
Grading Basis: Graded
Course Components: Lecture Required
Assessment: Critical Review 15%, Peer Assessment 15%, Presentation 15%, Report 55%
Pre-Requisites: Stage 2 Professional Engineering & Innovation
Co-Requisites: None
Compulsory Element: None
Course Contents
Lectures:
Introduction to enterprise; student example pitches; overview of Startup process; Intellectual property overview; funding opportunities; business consultancy approaches; importance of branding.
Self-working:

- Product development: derivation of product; creation of product specification; ethical and standards consideration, creation of prototype.
- Business development: team development; product development; marketing approaches; financial planning.
- Development of a challenging application: idea generation; application study; market study.

Supplementary Notes: None
Learning Outcomes:
General:

- Report writing.
- Business presentation.
- Assimilation of business practices.
- Generation of business ideas and products.

Specific:

- Ability to pitch business concept.
- Product development. (Tested by business pitch and plan)

Skills:

General:

- Presentational skills.
- Development of business acumen.
- Business plan creation.
- Team-working.
- Self-assessment.
- Creativity.

ELE 3045 - Power Electronics and Motor Drives

Course Detail

Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Components: Lecture Required, Practical Required
Assessment: Coursework 30%, Paper 50%, Practical 20%
Pre-Requisites: ELE2019 (Electrical Power Engineering 2)
Co-Requisites: None
Compulsory Element: None

Course Contents

- Introduction on power electronics:
  - Introduction, brief outline and the main purpose of this module. Applications and description of power electronics evolution.
- Power semiconductor devices:
  - Types and characteristics of switching power devices and their equivalent circuits including noni-deal characteristics.
- Review of electrical and magnetic circuit concepts:
  - Revision of basic electric and magnetic circuits that align with the applications of power electronics. Origin of losses in switching power devices including conduction and switching losses.
- Switched RLC circuits and diode rectifier:
  - Series and parallel operation of diode and reverse recovery characteristics of power diode. Steady-state capacitor voltage and inductor current in RLC circuits and the energy stored amount. The initial dv/dt and di/dt of RLC circuits.
- DC/DC converters:
  - Ideal transistor switch and switching techniques for DC/DC conversion. Types and the principle operation of DC/DC converters. Performance parameters, analysis and design of DC/DC converters.
- DC power supplies and DC drives:
  - Types of DC power supplies and circuits topologies. Operation, design and analysis of DC power supply. The basic characteristics of DC drives and their operating modes. Determining the performance parameters of DC/DC converter drives. Closed-loop and open loop transfer functions of DC motors.
- Pulse width modulated (PWM) Inverters:
  - Switching techniques of DC/AC converters (inverters) and their types. The operating principle and the performance parameters of inverters. Types of modulation techniques for obtaining sine wave and reducing the harmonics. Single-phase bridge inverters, current source inverters and variable DC-link inverter.
- Thyristor circuits:
  - Types of thyristors. Turn-off and turn-on characteristics of thyristors and explaining the limitations of thyristors. Series and parallel operations and di/dt & dv/dt protection.
- Controlled rectifier:

    - The controlled rectifiers operation, characteristics, and performance parameters. Analysis and design of controlled rectifier circuits. Single and three-phase full converters and pulse-width-modulation (PWM) control.
- AC voltage controllers:
    - Types, operation, and characteristics of AC voltage controllers. Operation of single-phase full-wave controllers with resistive and inductive loads.
- AC power supplies and AC motor drives:
    - Switched-mode, resonant, and bidirectional AC power supplies. Induction motor drives and vector control. Synchronous motor drives and design of speed controller.

Supplementary Notes: None

Learning Outcomes

- Understand the principles of power electronics
- Recognize and classify switching devices and their characteristics
- Describe the principle of operation of dc-dc converter
- Describe and determine the characteristics of converter drives
- Analyse the switching and modulation techniques for inverters
- Design and analyse the inverters
- Determine and analyse the controlled rectifier circuits
- Explain and determine the performance of motor drives
- Use computer-aided tools for power electronics circuits analysis
- Characterize a power electronics circuit using lab equipment.

Skills:

- The ability to link power electronics theory with the real life application
- Demonstrate programming and development skills in MATLAB
- Hardware design and analysis of a complete power electronic circuit.
- Enhancing teamwork skills, written and oral technical communication skills.

ELE 3046 - Advanced Electronics

Course Detail

Career: Undergraduate

Units: 20.00

Grading Basis: Graded

Course Components: Lecture Required, Practical Required

Assessment: Coursework 20%, Laboratory Project 15%, Paper 50%. Project 15%

Pre-Requisites: ELE2041

Co-Requisites: None

Compulsory Element: Laboratory Class

Course Contents:

- Review device physics and small signal analysis
- Common second order effects
- Different transistor configurations and amplifier classes
- Differential pairs with active load
- Feed-back circuits
- Frequency response and gain-bandwidth product
- Filter design
- Basic noise analysis

Supplementary Notes: None

Learning Outcomes:

- Understand advance concepts of analog circuit design.
- Analyse circuits with multiple transistors and op-amps.
- Build complex circuits using transistors and amplifiers.

Skills:

- Problem solving
- Circuit trouble shooting
- Analysis of complex analog circuits
- Simulation/computational modelling of analog circuits

Book Requirement

- Microelectronics Circuit Analysis and Design (4th Edition) by Donald A. Neamen.

STAGE 4

CSC 4003 - Algorithms: Analysis and Application

Course Detail
Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Components: Lecture Required, Tutorial Required
Assessment: Continual Assessment 30%, Paper 70%
Pre-Requisites: CSC2059 or CSC2058
Co-Requisites: None
Compulsory Element: None
Course Contents:
Analysis and design of algorithms, complexity, n-p completeness; algorithms for searching, sorting; algorithms which operate on trees, graphs, strings. Database algorithms, B-tree and hashing, disk access, algorithms. Applications of algorithms
Supplementary Notes: None
Learning Outcomes:
To understand some of the principal algorithms used in Computer Science; to be able to analyse and design efficient algorithms to suit particular applications.
Skills: Analysis, design and implementation of efficient algorithms.

CSC 4006 - Research and Development Project

Course Detail
Career: Undergraduate
Units: 40.00
Grading Basis: Graded
Course Components: Advisory Required
Assessment: Project 100%
Pre-Requisites: Only CS MEng students can enrol on this module
Co-Requisites: None
Compulsory Element: Submission of a preliminary research article, a final research article, and a software development report. A demo and presentation of a system. Regular meetings with supervisor.
Course Contents:
The project will take the form of a research investigation. A research problem should be investigated by developing a piece of software that can be used to generate research results. The results from the investigation should be analysed, validated and appropriate conclusions drawn.
Supplementary Notes: None
Learning Outcomes:
Following successful completion students will be able to demonstrate:

- Knowledge and understanding of a given research problem;
- The ability to investigate a research problem;
- The ability to develop a substantial software system;
- The ability to analyse results;
- The ability to conduct a survey of the literature;
- The ability to write an article and defend the research presented in it.

Skills: The ability to apply investigative skills, research skills and general software engineering principles to the solution of problems - which may require investigative, practical or design skills or a combination of all three. Originality is encouraged.

CSC 4008 - Digital Transformation: Software Design, Management and Practical Implementation

Course Detail
Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Components: Lecture Required
Assessment: Project 100%
Pre-Requisites: This group based module is only available to students enrolled on either the MEng in Computer Science, the MEng in Software Engineering, the MEng in Electronics and Software Engineering or the MSci Maths and CS degree programmes.
Co-Requisites: None
Compulsory Element: Submission of project report.
Course Contents: Opportunity Analysis, Entrepreneurship and Innovation, Business Planning, Modelling and documenting software design; Software Design principles and patterns; Software Architecture; Modern approaches to software design; Legal Social and Ethical considerations, Software Project and Team Management
Supplementary Notes: None
Learning Outcomes:
Students will:

- Have a good knowledge of market evaluation, opportunity scoping, background research and software design related to a modern commercial setting.
- Gain the ability to evaluate systems in terms of architecture, general quality attributes and possible trade-offs presented within the given problem.
- Gain knowledge of the commercial and economic context of the development use and maintenance of computer-based systems.
- Be able to frame the opportunity within an innovative business model outlining the overall requirements i.e. model and analyse the extent to which a computer-based system meets the criteria defined for its current need, use and future development.
- Recognise the legal, social, ethical and professional issues involved in the exploitation of 36 computer technology and be guided by the adoption of appropriate professional, ethical and legal practices.
- Be able to apply analytical skills within a team to a practical commercial opportunity.
- Understand the realisation of software requirements as software designs.
- Appreciate how to operate and contribute as part of a team, understanding the different ways of organising teams and the roles within a team in the development and delivery of an end-to-end software solution.
- Gain appreciation of risk management within the development process from an end user, commercial, team and individual perspective.
- Deploy effectively suitable tools for the construction and documentation of computer applications and to use and apply information from technical literature

Skills:
Knowledge of opportunity analyses, business modelling, and commercial delivery of software against a created set of requirements

CSC 4009 – Fairness, Interpretability and Privacy in Machine Learning

Course Detail
Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Components: Lecture Required, Practical Required
Assessment: Assignment 1 30%; Assignment 2 30%; Paper 40%

Pre-Requisites: CSC3067 – Video Analytics and Machine Learning
Co-Requisites: None
Compulsory Element: None
Course Contents:

- Machine Learning and Fairness: How ML algorithms could make unfair decisions
- The Political and Philosophical Underpinnings of ML Fairness
- Overview of some recent Fair AI algorithms
- Machine Learning and Interpretability: The case for explainable and transparent ML
- Overview of how some recent Interpretable AI algorithms, and how they operationalize interpretability
- Machine Learning and Privacy: How ML could (inadvertently) violate privacy
- Overview of recent advances in Privacy oriented ML
- Situating Fairness, Interpretability and Privacy within the broader ML ethics context

Supplementary Notes
None
Learning Outcomes
Be able to:

- Understand the risks of socially applied ML along several ethics dimensions.
- Critically analyse ML algorithms with respect to fairness and deliberate on improvements.
- Critically analyse the interpretability of ML algorithms, and contemplate on improving their interpretability characteristics.
- Understand the privacy implications of ML algorithms, and develop pathways towards enhancing privacy.
- Communicate findings and decision making processes grounded on data and ethical principles.

Skills
Problem solving. Self and independent learning. Research. Working with others and organisational skills. Critical analysis. Quantitative evaluation. Mathematical and logical thinking.

CSC 4010 – Parallel and Distributed Computing

Course Detail
Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Components: Practical Required
Assessment: Continual Assessment 100%
Pre-Requisites: None
Co-Requisites: None
Compulsory Element: None
Course Contents:
This module focuses on approaches to use multiple compute resources simultaneously to solve problems. Parallel programming is the use of closely located normally homogeneous computing resources such as multicore processors, high performance clusters or supercomputers to speed computation up through simultaneous execution. Distributed computing is the opposite end where multiple heterogenous systems with unreliable and/or slow communication links are used to spread workload.
This practically oriented module will cover the theory and implementation of parallel and distributed systems using different programming techniques, environments and concepts.
Topics covered will include:

- Basic concepts and terminology
- Parallel programming models
- Program and problem analysis
- Practical parallel programming and implementation of parallel code
- Distributed computing theory
- Data synchronisation methods

Supplementary Notes
None
Learning Outcomes
To demonstrate understanding of:

- The principles underpinning effective and efficient parallel programs
- The principles underpinning effective and efficient distributed computing
- Implementation of parallel and distributed solutions in an efficient fashion
- Modern multi-threaded execution environments and software development architectures

Skills
Improving Own Learning and Performance, Problem Solving, planning and researching assignments, design and implementation of solutions

ECS 4002 - Wireless Sensor Systems

Course Detail
Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Components: Lecture Required
Assessment: Coursework 15%, Laboratory Project 25%, Paper 60%
Pre-Requisites: None
Co-Requisites: None
Compulsory Element: None
Course Contents:
Lectures and Schedule:

- Introduction
- Sensor Systems
- Zigbee, 6LoWPAN
- 802.11 MAC layer
- Low Power WSN MACs
- Reading week (Research for Presentation)
- Presentations
- IoT 802.11ah
- Lab 1
- Lab 2
- Class Test
- IoTLoRAWAN and other IoT
- Rouiting for WSN
- PowerManagement
- Synchronization
- Localization
- Lab3
- Lab4
- Tutorials
- Lab5 (Showcase)

Coursework:

- Presentation (Research literature in Sensors and Presentation)
- Class test (Semester 1)
- Laboratory and Report (Semester 2)

Laboratory:

- Lab 1. Sensor System Introduction.
- Lab 2. Reading Sensor Data
- Lab 3. RTC interfacing and data logging
- Lab 4. Comparing sensor data and data analysis

Supplementary Notes
Presentation slides, Tutorials, Reference Textbook

Learning Outcomes

The following LOs are provided through examination, laboratory and coursework (class test and presentation) with significant overlapping of LOs across assessment elements.

Science and Mathematics Learning Outcomes:

- Wireless Sensors Systems: sub-systems and challenges (SM1m).
- Throughput and delay calculations. Time synchronization and localization. Power consumption calculations (SM2m).
- Understanding of telecommunications protocols. Understanding of PHY layer. Apply knowledge to wireless sensor technologies (SM3m).
- Enabling technologies for the Internet of Things. Recent standardization activity on these new technologies (SM4m).
- Understanding of random access principles, contention and contention resolution. Appreciation of the limitations that these impose on future high dense wireless networks. (SM5m).
- Understanding of hardware architectures, sensor technology and communication architectures. Applying them effectively when designing a wireless sensor system in coursework/laboratory. (SM6m).

Engineering Analysis LOs:

- Understanding of basic PHY layer principles such as coding and modulation. Impact on throughput. (EA1m).
- Performance assessment of layer 2 technologies (throughput and delay). (EA2m).
- Time synchronization protocols. Non determinism of communication latency. Calculation of delay and offset. Critical path. Limitation of some synchronization protocols. Alternative protocols. (EA3m).
- Integrating different subsystems (sensors, microcontroller, communication sub-subsystem) to provide engineering solutions, data acquisition and analysis through laboratory challenge. (EA4m).
- Investigation of emerging technologies that enable IoT. IEEE 802.11ah. LoRaWAN (EA5m).

Design LOs:

- Literature review of sensors and comparison (presentation). Presentation on a scientific paper of their choice in this context. (EA6m) (Design D6m).
- Design of a wireless sensor system in laboratory to address a specific challenge/need (e.g. pollution monitoring, light and temperature sensing, calibration and comparison of data sets). (D8m)
- Economic, Social and Environmental Context LOs:
    - Study of subsystems and commercial sensors to provide a wireless sensor system solution in lab (ET2m).

Engineering Practice LOs:

- Knowledge of wireless technologies (ZigBee, WiFi). IoT technologies: IEEE 802.11ah, LoRaWAN.
- Extensive knowledge of sensors. (EP2m).
- Research on sensors and sensor comparison for presentation. (EP4m).
- Understanding of recent standards for IoT communication technologies: IEEE 802.11ah. (EP6m).
- Appreciation of new developments in IoT (systems and platforms). (EP9m).
- Consideration of commercial components and constraints in lab. (EP10m).
- Understanding of different roles in a collaborative project. Initiative and personal responsibility for their individual role.(EP11m).

Skills

- Effective communication of knowledge and ideas.
- The ability to critically assess and design modern wireless communications systems and in particular wireless sensor networks and systems using data acquisition boards.
- The ability to understand existing system architectures and standards in such a context.
- Use embedded software to program arduino based systems and perform sensor data acquisition, data analysis.

ECS 4003 - Advanced Computer Engineering

Course Detail
Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Components: Lecture Required
Assessment: Coursework 100%
Pre-Requisites: None
Co-Requisites: None
Compulsory Element: None
Course Contents:

- Streaming workload modelling languages
  - Algorithm optimisation schemes
  - Handling of time in algorithm design
  - Number systems and operations
  - High Level Synthesis (HLS) technology for Field Programmable Gate Array (FPGA)
  - Application partitioning for parallel processing platforms
  - System optimisation

Supplementary Notes: None
Learning Outcomes: Understand the design principles for design of heterogeneous hardware/software embedded digital signal processing (DSP) systems, in five specific areas: computing architectures, application modelling, parallel partitioning, scheduling and code generation, and implementation optimisation.

- In the area of computer architectures, students will be able to:
  - The influence of number system on accuracy and cost of different number systems
  - Handling time and dependency in custom architecture design
  - Discriminate how behavioural expressions of a function translate to circuit architectures using High Level Synthesis (HLS) technology.
- In the area of application modelling and code generation, students will be able to:
  - Analyse and compare dataflow languages for a given application
  - Derive firing rules for dataflow actors
  - Apply mathematical consistency checks to static dataflow models
  - Appraise the implementation concerns of parallel processing algorithms
  - Investigate constructive hierarchical and multi-stage partitioning algorithms
  - Relate constructive and iterative partitioning algorithms
  - Relate partitioning algorithms to achieve specific implementation goals
  - Analyse dataflow models for deadlock
  - Analyse the code and data memory requirements, throughput and efficiency of the resulting embedded schedules
- In the area of optimisation of custom systems, students will be able to:
  - Outline the behaviour of system optimisation approaches.
  - Contrast graph transformation techniques for optimisation of embedded dataflow schedules
  - Transform embedded schedules for optimisation with respect to data memory, throughput and efficiency
  - Relate advanced dataflow models for further optimisation with respect to a given criteria
  - Illustrate retiming, folding and unfolding, hardware sharing for dedicated hardware optimisation

Skills

- Assimilation of technical material
- Critical thought in the design of resource-constrained computer designed problems
- Application to practical data processing design examples

ELE 4001 - Project 4

Course Detail
Career: Undergraduate
Units: 40.00
Grading Basis: Graded
Course Components: Practical Required
Assessment: Coursework 100%
Pre-Requisites: 6 x Stage 3 modules
Co-Requisites: None
Compulsory Element: Showcase Demo, Final Report
Course Contents:
The project normally takes the form of an investigation or design study concerned with one of the various branches of electrical and electronic engineering. The project originator typically endeavours to ensure an element of design, manufacture and test in the project specification, even if the project is software-based. There are of necessity many variations on this theme.
Supplementary Notes: None
Learning Outcomes: To develop the ability to conduct a substantial project over an extended period; to perceive the nature of engineering problems or product specifications; to acquire and develop the necessary skills and to plan and execute a suitable programme of work.
Skills: The ability to apply general principles and design or analytical techniques to the solution of engineering problems - which may require investigative, practical or design skills or a combination of all three. Originality is encouraged.

ELE 4009 - Wireless Communications

Course Detail
Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Components: Lecture Required
Assessment: Class Test 20% Paper 60%, Project 20%
Pre-Requisites: None
Co-Requisites: None
Compulsory Element: None
Course Contents:
Lectures:
Wireless communication systems are a primary enabling technology in the realisation of a smarter connected society. This course provides a fundamental understanding of the concepts and techniques used in the design of modern wireless communication systems. In particular it covers the following topics:

- Cellular systems
- Propagation modelling
- Spectrum management
- Multiuser systems (multiple access, multiuser diversity techniques)
- Multiple antennas (e.g., maximal ratio combining, MIMO techniques)
- Multicarrier communications
- Multiuser scheduling techniques (e.g., greedy access, proportional fair)
- Cognitive radio techniques

Coursework:
The coursework will assess the following topics:

- Wireless channel modelling
- Modulation.
- Performance analysis of wireless communication systems.

Supplementary Notes
None

Learning Outcomes
General:
Students should acquire an understanding of mobile and cellular systems [SM1m]; demonstrate a knowledge of the wireless channel propagation characteristics; be able to examine the advanced concepts and techniques which allow modern wireless communication systems to be designed and assessed against a given operational specification [SM2m, SM3m, EA2m]; understand the future development of wireless systems and their limitations (including social and economic implications) [SM4m, EA5m, ET2m].
Coursework [SM6m, D6m, EA3m, EP11m]:
The coursework will develop a practical understanding of the different types of wireless channels encountered in wireless communication systems [SM6m, EA3m]. It will also familiarise the student with simple digital modulation and demodulation techniques and the performance analysis of wireless communication systems [EA3m]. It will further develop team-work and presentation skills through group-based project work and project presentation [D6m, EP11m].
Students will also have gained experience of Matlab functions useful for the wireless channel modelling, wireless system simulation, performance debug and test [EA3m, EA5m].
Skills
General:
Assimilation of lecture material, Matlab skills, system model and problem-solving skills as well as basic probability and random theories [SM2m].

ELE 4023 – Control Methods for Cyber-Physical Systems

Course Detail
Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Components: Lecture Required
Assessment: Coursework 75%, Class Tests 25%
Pre-Requisites: None
Co-Requisites: None
Compulsory Element: None
Course Contents:

- Modelling and simulation of continuous-time and discrete-time systems, connections between them and discretisation methods
- Solutions, similarity transformations and special forms
- Reachability/controllability and observability/detectability
- Linear state and output feedback controllers, variations, separation principle
- State observers
- Lyapunov stability and related numerical methods
- Linear Quadratic Regulators and Model Predictive Control
- Invariance and constrained control, set-theoretic approaches
- Introduction to types of hybrid systems, simulation and examples
- Switching systems; examples, analysis methods and control approaches
- Hybrid automata, solutions, Zeno behaviour, concepts in abstraction, bisimulation, model checking/ formal verification

Supplementary Notes:
- Worked out examples for self-study
- Sample code for programming examples
- Supplementary material provided for advanced topics for self-motivated study

Learning Outcomes:
Specifically, at the end of the module you should be able to:

- Have a good knowledge of classic state-space (control and estimation) methods for control and estimation
- Have a good knowledge of stability and safety analysis algorithms for dynamical systems
- Have a good knowledge of modelling cyber-physical systems as hybrid systems
- Know how to apply numerical methods for stability analysis and control design of general dynamical systems

Skills:

- Modelling of complex dynamic systems in engineering
- Advanced technical knowledge related to control design, estimator design, safety analysis for complex systems
- Mathematical reasoning.
- Software/Programming skills

ELE 4024 – Robotics and Intelligent Systems

Course Detail
Career: Undergraduate
Units: 20.00
Grading Basis; Graded
Course Components: Lecture Required
Assessment: Coursework 20%, Coursework 20%, Exam 60%
Pre-Requisites: None
Co-Requisites: None
Compulsory Element: None
Course Contents:
The contents of the course include:
Part 1: An introduction and overview to the various core aspects of robotics including:

- Kinematic: position and orientations, forward kinematic, and inverse kinematic.
- Dynamics and control system: Robot dynamics, Path planning and trajectory, Computed torque control, and Cartesian control.

Part 2: Fundamental concepts and architectures of:

- Robot-vision system: vision sensors, issues of vision guided robotics, visual servoing.
- Force-based robot control: Stiffness control, hybrid position/force control, Impedance Control, and Admittance Control.
- Manufacturing robots: An overview of Robots in manufacturing, Robots for pick and place applications, Robots for finishing applications.

Part 3: Fundamental principles of intelligent techniques:

- Machine learning: Learning system model, Machine learning structure, Learning techniques, Reinforcement learning, Applications to Robotics.
- Neural network: Perceptron as a classififer, Adaline and speepest descent algorithm, Multilayer Perceptron (MLP) networks, Back propagation training algorithm, LMS algorithm.
- Fuzzy logics: Fuzzy logic and fuzzy sets, fuzzification and defuzzification, fuzzy control.

The module has a final written examination and two coursework (coursework 1: calculate kinematic and dynamic of robot, and coursework 2: design intelligent controller for robot). The coursework 1 accounts for 20% of the final mark, the coursework 2 accounts for 20% of the final mark, while the final exam contributes 60%.
Supplementary Notes: Tutorials sheets with solutions for self-study
Learning Outcomes:
At the end of this module students will be able to:

- Demonstrate a good understanding of robots' structure, their dynamics, control system and associated sensor and actuator technology.
- Demonstrate a good understanding of robot-vision system.
- Design visual servicing controllers for robot-vision applications.
- Understand how to design force-based control schemes for practical applications.
- Design force-based controllers.
- Understand how to build a robot system for a particular application in manufacturing.
- Demonstrate a good understanding of machine learning, neural network and fuzzy logic.

- Use machine learning for classification.
- Use neural network for classification or approximation.
- Design fuzzy logic controllers for robotic applications.

Skills:
The module will give you good knowledge about robot kinematics and dynamics, actuators and sensors, experience of how to design a robot system and its controller for a particular application. Furthermore, you will have knowledge of a range of intelligent systems techniques and how to apply them for robotic applications.

ELE 4025 – Sustainable Energy and Smart Grids

Course Detail
Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Components: Lecture Required
Assessment: Coursework 40%, Exam 60%
Pre-Requisites: None
Co-Requisites: None
Compulsory Element: None
Course Contents:
Lectures:
Sustainable Energy

- Sustainable Energy Resources
- Load Frequency Control, Dynamics, Inertia
- System Non-Synchronous Penetration (SNSP)
- Demand Side Management, Deferrable Loads
- Battery Energy Storage
- Electric Vehicles

Smart Grids:

- Substation Automation
- Telecommunications
- Phasor Measurement Units
- Power Quality
- Design & Deployment
- Market Liberalisation and Economics
- Renewable Energy Operations and Integration

Coursework:
Two written assignments on a topic related to those described above.
Supplementary Notes: None
Learning Outcomes:
On completion of this module, a student will have achieved the following learning outcomes commensurate with module classification:

- Understand the main elements and attributes of sustainable energy and smart grid systems.
- Determine factors which determine growth in system demand.
- Identify economic and environmental impacts of various energy resources.
- Manage constraints in power systems through active network management.
- Design and implement frequency regulation techniques in low inertia systems.
- Determine and design appropriate methods of power system protection.
- Describe the changing nature of measurement systems in electrical infrastructure and the motivation for real-time monitoring.
- Determine the challenges involved in providing telecommunications connectivity, choosing the correct standards, and providing adequate reliability and security.
- Implement suitable communications for power system monitoring and protection.
- Acquired knowledge of the latest protection and control techniques that can be applied in the Smart Grid environment.

- Specify appropriate power delivery solutions, including wind and distributed generation options.
- Demonstrate understanding of power system measurement.
- Determine power quality requirements necessary for equipment integration.
- Understand appropriate design and deployment strategies.
- Identify risks and vulnerabilities in communications and cybersecurity.
- Determine economic metrics for power system markets.

Skills:

- Numerical and problem-solving skills.
- Planning of small- and large-scale energy resources and analysis of global energy resources.
- Be able to synthesis the broad skills set of telecoms design, measurement and control within the power system utility environment.
- Develop interpersonal/team skills in a collaborative working environment.

EEECS

MODULE

DESCRIPTIONS

BIT ONLY

2024-2025

STAGE 1

CSC1023 – Databases

Course Detail
Career: Undergraduate
Unit: 20.00
Grading Basis: Graded
Course Components: Lecture Required, Practical Required
Assessment: Class Test 30%, Project 30%, Timed exam on Computer 40%
Pre-Requisites: None
Co-Requisites: None
Compulsory Element: Written Examination. Satisfactory completion of all practical elements.
Course Contents
Databases

- Introduction to the fundamental concepts in database systems
- Exploring and solving real world problems using data models and schemas.
- Creating and designing Relational databases including Tables, Fields, Keys and Joins
- Managing a relational database using Structured Query Language (SQL)
- Formal Approaches to Relational Database Design (normalization theory, dependency theory).
- Advanced Topics on Modern Data Management (data extraction, mining, integration).
- Database access from a programming language (e.g. Java) including being able to display, modify, delete and update data on it.

Supplementary Notes: None
Learning Outcomes:
Be able to:
Databases

- Demonstrate knowledge, understanding and the application of the fundamental concepts of basic database systems.
- Demonstrate knowledge, understanding and the application of the fundamental concepts in data modelling and database schemas
- Demonstrate knowledge, understanding and the application of the fundamental concepts of SQL queries to manage a relational database including Create, Insert, Select, Delete and Update.
- Demonstrate knowledge, understanding and the application of using a programming language to connect, manage and execute SQL queries.

Skills: Application of Number, ICT, Improving Own Learning and Performance, Problem Solving.

CSC 1024 - Programming and Systems Development

Course Detail
Career: Undergraduate
Units: 40.00
Grading Basis: Graded
Course Components: Lecture Required, Practical Required
Assessment: Individual Contribution 35%, Practical Exam 10%, Project 35%, Class Test 20%
Pre-Requisites: None
Co-Requisites: None
Compulsory Element: Students must complete all elements of module assessment and attain an overall pass.
Course Contents
This module will introduce the fundamentals of programming. You will explore real-world problems through worked programming examples which will encompass learning good algorithm design. This will be achieved using appropriate programming constructs such as assignment, selection and repetition. You will also be introduced to simple data structures and object-oriented programming.

Supplementary Notes: None
Learning Outcomes: Students must be able to:

- Demonstrate knowledge, understanding and the application of the principles of procedural programming, including:
  - Primitive data types
  - Simple abstract data structures, i.e. strings and arrays
  - Sequencing, selection and iteration
  - Functions/methods and composition
  - Input/output and error handling
- Demonstrate knowledge and understanding of the principles of object-oriented programming, including:
  - Classes, objects and inheritance
- Analyse real-world business challenges in combination with programming concepts and data manipulation to write code in an effective way to solve the problem.
- Fully test a system by applying user acceptance testing
- Demonstrate knowledge, understanding and the application of the software systems design with a focus on users and key stakeholders, including
  - Classification of user/system requirements in line with the problem domain
- Demonstrate knowledge, understanding and the application of working as part of a team to deliver a solution to a client

Skills:
KNOWLEDGE & UNDERSTANDING: Understand fundamental theories of procedural programming
INTELLECTUAL AND PRACTICAL:

- Be able to design and develop small programs, which meet simple functional requirements expressed in English.
- Programs designed, developed and tested will contain a combination of some or all of the features as within the Knowledge and Understanding learning outcomes.

ACC1002 - Accounting

Course Detail
Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Component: Computer Based Learning Required, Lecture Required
Assessment: Class Test 1 30%, Class Test 2 50%, Online Assessment 20%
Pre-Requisites: None
Co-Requisites: None
Compulsory Element: Students must achieve an overall mark of 40% in the module to pass.
Course Contents
Use of accounting information in business: the balance sheet, income statement and cash flow statement, and introduction to ratio analysis; introduction to costing, accounting for overheads, budgeting, variance analysis and contribution analysis.
Supplementary Notes:
Students enrolled for ACC1001 or ACC1003 may not enrol for this module. Students may only take this module if it is a compulsory, or specified optional, part of their degree programme.
Learning Outcomes: Students must be able to:

- Appreciate the purposes for which accounting information is used in business;
- Understand how that information is gathered, processed, and presented;
- Use quantitative and qualitative techniques to aid problem solving;
- Demonstrate development of technical skills in preparing and interpreting basic accounting information

Skills: Students should be able to develop their:

- IT and electronic-based learning skills;
- Independent learning skills;
- Time-management skills

ECO1007 – An Introduction to Economics

Course Detail
Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Components: Lecture Required, Tutorial Required
Assessment: Continual Assessment 40%, Paper 60%
Pre-Requisites: None
Co-Requisites: None
Compulsory Element: Students must achieve an overall mark of 40% in the module to pass
Course Contents
This module introduces students to economic approaches to the study of organisations. The module examines: why organisations exist in a market context; the role of the entrepreneur; buyer behaviour; production and costs; the pricing decision and game theory; how the firm makes profits; the firm as a focal point for a set of contracts; the principal-agent problem; growth and innovation; the macro-economic environment.
Supplementary Notes: None
Learning Outcomes: On completion of the module you will have acquired:
Knowledge and understanding:
Students will gain an understanding of both the textbook applications of theory and real world managerial practice. The course will cover standard topics such as demand and supply, production and cost, pricing decisions, market structures, mergers and vertical integration, R&D etc.
Intellectual skills:
Students will gain an understanding of how economists think and how to engage in economic analysis. They will also get some understanding of the economic techniques that are available to address business problems and the strengths and weaknesses of these techniques.
Practical skills:
Students will develop organizational skills, communication skills, presentation skills and word processing skills.
Skills:
The aim of this module is to introduce students to the relevance of economic analysis to managerial decision making. Economics is central to understanding management and underpins many functional decisions, e.g., in marketing, finance, production and human resources.

MGT1009 (OWL1009)– Organisational Behaviour

Course Detail
Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Components: Lecture Required, Seminar Required
Assessment: Continual Assessment 60%, Presentation 40%
Pre-Requisites: None
Co-Requisites: None
Compulsory Element: Students must achieve an overall mark of 40% in the module to pass.
Course Contents:
Organisations of one form or another play an important part of society and serve many important needs. They vary greatly in size, complexity and the activities they undertake. To achieve organisational goals people working in organisations have to be managed. The module explores three key areas. Firstly, the factors that influence individuals such as personality, attitudes, perception, motivation, learning, communication and job satisfaction. Secondly, the factors that influence the nature of groups and teams and the importance of leadership. Thirdly, the module explores the nature of organisations by analysing issues such as goals, structure, design, control, culture and development.

Supplementary Notes: Only students who are registered in the following programmes of study, can complete this module: Business Economics and Business Information Technology
Learning Outcomes: Upon successful completion of the module students should be able to:

1. Understand a range of factors that influence the behaviour of individuals in organisations such as personality, perception, communication, motivation and learning.
2. Understand a range of factors that influence the behaviour and development of groups and teams in organisations and be aware of the nature of leadership.
3. Understand the nature and complexity of organisations by exploring issues such as goals, strategy, structure, design, control and development.
4. Possess an awareness of the changes that continually impact on individuals and groups and influence the nature of organisations.
5. Apply the learning acquired to other elements of the degree programme.

Skills:

- Critically evaluate information and its veracity in relation to organisational behaviour
- Apply logic and reasoning to scenario based situations and problem solving
- Communicate ideas, critique theoretical frameworks and discuss their strengths and shortcomings in a range of business environments. Communication will be in both written and presentational forms
- Use ICT software effectively
- Work both independently (summative assessment) and in groups (formative assessment)
- Manage own time and workloads effectively
- Pursue independent enquiry

MGT1012 (OWL1012) – Business, Government and Society

Course Detail
Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Components: Lecture Required, Tutorial Required
Assessment: Group Work 40%, Paper 60%
Pre-Requisites: None
Co-Requisites: None
Compulsory Element: Students must achieve an overall mark of 40% in the module to pass
Course Contents
The module explores the role of business in its wider environmental context and specifically explores the relationships between business, government, and society within and across countries. Businesses do not exist and act in a vacuum but rather have to interact with and oftentimes accommodate the views of a wide range of stakeholders in order to be successful. For example, Multinational Enterprises may decide to shift production into low-cost countries, however, they have to consider the societal and legal challenges that this decision generates, both at home and abroad. Organisational structures and corporate governance frameworks are thus developed to ensure that businesses can engage with these wider social and public policy contexts. As a result, businesses are becoming more deeply rooted in and intertwined with local, national and international communities.
Indeed, beyond a narrow profit making focus, there is a growing acceptance that corporate interests can and should converge with societal interests to generate better, sustainable outcomes for the business in the long term. However, balancing the drive to make profits and to satisfy short-term shareholder interests with the long-term needs of society and its environment is tough. Consideration must be given to developing sustainable and responsible businesses. Students will learn about the challenges that businesses but also students themselves face in day-to-day (business) life and will discuss and develop different solutions to these challenges.
Supplementary Notes: Classes will be scheduled over weekly two hours lectures and tutorials and key topics and concepts will be introduced and discussed through interactive sessions. Participation is expected in each class as is the reading of the required materials for each class.

Learning Outcomes: Successful completion of the module will enable students to:

- Explore the needs and responsibilities of different stakeholder groups and their impact on business
- Critique the role of business in society
- Develop an understanding on the impact of business on all facets of society
- Analyse and evaluate the relationships within and between business, government and society
- Explain the complexities that characterise the relationships between business, government and society at different levels of governance

Skills:
The module aims to give students a sound introduction to issues concerning the interactions and relationships between business, government and society. It will orientate students toward better and more acceptable decisions in business.

MGT1013 (IBEM1013) - Marketing

Course Detail
Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Components: Lecture Required, Seminar Required
Assessment: Continual Assessment 60%, Group Work 40%
Pre-Requisites: None
Co-Requisites: None
Compulsory Element: Students must achieve an overall mark of 40% in the module to pass
Course Contents
Marketing is a key factor in business success. On a daily basis we are exposed to a plethora of marketing messages and actively engage in the marketplace and/or marketspace. Often our purchasing decisions are heavily influenced by organisational marketing efforts. We 'display' our favourite brands through the clothes we wear, the cars we drive and the football teams we support. Marketing is everywhere! It is an inescapable feature of our contemporary world.
Supplementary Notes: This module may only be taken if specified on an approved degree programme.
Learning Outcomes: Successful completion of the module will enable students to:

1. Understand the nature, scope and role of marketing in organisations.
2. Identify and discuss the key issues that marketers face as they make decisions.
3. Discuss the key concepts and theories that inform marketing decision making; and examine some key marketing concepts, theories and associated issues in depth so as to be able to contribute to current debate relating to marketing strategy in local, national and international markets.

Skills: The focus of the module is on the theory and practice of marketing in the context of organisations. The module will provide students with insights into the issues and tasks that marketing managers' face in complex and dynamic marketplaces (and marketspaces) and the concepts and theories that can be used to inform marketing decision making.

STAGE 2

CSC 2054 – User Experience Design
Course Detail
Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Components: Lecture Required, Practical Required
Assessment: Project 100%
Pre-Requisites: None
Co-Requisites: None
Compulsory Element: Normally, all elements of summative assessment must be attempted.
Course Contents

- Ergonomics: ergonomics; accessibility; minimising mistakes; analysis and testing; case studies.
- Human Factors: human senses; human movement and speech; human memory; human intellect
- Prototyping: types of prototyping; low fidelity prototyping; exercise; high fidelity prototyping.
- Design Principles: universal design; principles and guidelines; interaction styles; patterns.
- User Interfaces: design implementations of human cognition; layout; navigation; text.
- Usability Metrics: usability; assessment; qualitative assessment; quantitative assessment.
- Usability Heuristics: heuristic evaluation, usability heuristics; specialised heuristics.

Supplementary Notes: None
Learning Outcomes - Be able to:

- Demonstrate understanding of the role of human factors, effective design, prototyping and usability evaluation in the development of software and hardware products.
- Develop appropriate user interfaces for specific applications and specific users using low and high-fidelity prototyping.
- Assess the usability of an application with respect to different user populations.

Skills:
Communication, Improving Own Learning and Performance, Problem Solving, Working with Others

CSC 2057 – Modern Web App Development
Course Detail
Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Components: Lecture Required, Practical Required
Assessment: Continual Assessment 30%, Project 70%
Pre-Requisites: CSC1024 Programming and Systems Development
Co-Requisites: None
Compulsory Element: Normally, all elements of summative assessment must be attempted.
Course Contents: Web developers work with a combination of different technologies, e.g. server-side scripting languages, JavaScript, SQL and they may also specialise in other web development stacks. The course will explore one modern server-side programming language with the traditional client-side technologies such as JavaScript and CSS that are used in developing modern dynamic web applications. Further to this, other areas of software engineering will also be studied in order to implement real-world and web-based software solutions.
Supplementary Notes: None
Learning Outcomes: Students shall be able to:

- Demonstrate knowledge and understanding of the principles of web development technologies to include:
    - Principles of Python programming for web deployment

- Demonstrate knowledge and understanding of the principles of the associated technologies that support web-based application development to include:
    - Practices of client-side technologies e.g. JavaScript, HTML and CSS.
    - Practices of RDBMS e.g. SQL and MySQL.
- Demonstrate the ability to build and deploy real-world web-based software solutions to include:
    - Principles of solution-based design
    - Practices of software system development, deployment and testing
    - Principles of performance, optimization and rendering.

Skills:

KNOWLEDGE & UNDERSTANDING:

- Understand the fundamentals of several modern, open-source server-side programming language.
- Understand the fundamentals of the following areas in web development: web based software system design, full stack development, and web based application deployment.
- Understand the fundamentals in software engineering: development methodologies, testing and security.

CSC 2065 – Professional and Transferrable Skills

Course Detail

Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Components: Advisory Required, Lecture Required, Practical Required
Assessment: Continual Assessment 100%
Pre-Requisites: None
Co-Requisites: None
Compulsory Element: None
Course Contents:

This module will prepare students for employment by developing an awareness of the business environment and the issues involved in successful career management combined with the development of key transferrable skills such as problem solving, communication and team working. Students will build their professional practice and ability to critically self-reflect to improve their performance.

Key elements will explode legal, social, ethical and professional issues (LSEPIs) including intellectual property, computer-aided crime, data protection and privacy including GDPR, security, net neutrality, communication through technology, cultural sensitivity and gender neutrality. The British Computer Society (BCS) code of conduct will be exploded and understood.

Supplementary Notes: None
Learning Outcomes:

- To prepare students for employment in industry and research through developing an awareness of the business environment and key skills.
- To develop and demonstrate a range of transferrable skills including communication skills, presentation, group working and problem solving.
- To develop skills in critical reflection of self and others feeding into improvements.
- To explore legal, social, ethical and professional issues (LSEPIs). Examples of areas to be explored will relate to: Intellectual Property, Computer Crime, Work Quality, Challenges of On-line content Quality, Digital Divide including Net Neutrality, Privacy including GDPR, Security, Globalisation, Communication through effective use of technology, Cultural Sensitivity, Gender Neutrality. British Computer Society (BCS) Code of Conduct will be explored covering Public Interest, Professional Competence and Integrity, Duty to Relevant Authority and Duty to the Profession.

Skills: Problem synthesis and resolution as an individual and as part of a team. Development and use of suitable communication mechanisms. Business and Professional awareness.

MGT2009 (ITAO2009) – Data and Statistics
Course Detail
Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Components: Lecture Required, Computer Based Learning
Assessment: Project 1 40%, Project 2 60%
Pre-Requisites: MGT1009 (now OWL1009)
Co-Requisites: None
Compulsory Element: Students must achieve an overall mark of 40% in the module to pass
Course Contents:
The aim of this module is to develop students' knowledge and skills of business research methods which are essential for the business world as well as other modules within the degree programme. This module introduces secondary and primary research and the main qualitative and quantitative methods employed in management practice. In particular, students should acquire an understanding of the issues of data collection, measurement, sampling, analysis and presentation of results.
Supplementary Notes: This module can only be taken if the student is on an approved degree programme.
Learning Outcomes:
On successful completion of this module you will be able to:
1. Utilize both secondary and primary data collection methods in research design.
2. Learn to distinguish appropriate methodologies for task related problem identification and solving.
3. Utilize a statistical package, SPSS to apply and interpret basic statistical methods.
4. Interpret and disseminate research results and findings.

Skills:
Students should be able to:
1. Apply critical analytical skills and problem-solving skills to a variety of different situations.
2. Synthesize, analyze, interpret, and critically evaluate information from a variety of different sources.
3. Work effectively as an individual and as part of a team

MGT2011 (IBEM2011) – International Business
Course Detail
Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Components: Lecture Required, Seminar Required
Assessment: Coursework 60%, Coursework 40%
Pre-Requisites: MGT1009 (now OWL1009)
Co-Requisites: None
Compulsory Element: Students must achieve an overall mark of 40% in the module to pass
Course Contents:
Students on this module will develop a sophisticated understanding of the complex global economic, political, legal and cultural environment and a deep appreciation of how this affects the strategies, operations and decisions of organisations and professionals who operate in an international business context. Students will also become familiar with a variety of organisation forms, operating modes and activities relevant to international business.
Supplementary Notes: This module may only be taken as part of an approved degree programme.
Learning Outcomes:
On successfully completing this module, the students are expected to be able to:
1. Demonstrate a critical understanding of how international business is affected by key factors such as culture, politics, economics, environment, and ethical considerations.

2. Integrate information on these key factors in preparation for decision-making in international business.
3. Apply the understanding of these key factors to a range of specific decision-making situations in international business.

Skills:

On completing the module, students should have improved their skills in three areas:

1. Improved personal transferable skills:
   Full participation in this module will also contribute to the development of programme-level transferable skills like: independent inquiry; critical analysis and interpretation; finding, organizing and synthesizing information; teamwork; communication (written and presentation).
2. New subject specific skills: Ability to apply relevant theories and concepts to the analysis and interpretation of case study examples and real-world managerial dilemmas in international business.
3. General conceptual skills:
   By exploring the dilemmas linked to managing in a global business environment the module enhances student problem-solving and analytical competencies. The general philosophy of the module is to encourage critical thinking and higher learning.

MGT2013 (OWL2013) – Human Resource Management

Course Detail

Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Components: Lecture Required, Seminar Required
Assessment: Coursework 60%, Practical 40%
Pre-Requisites: MGT1009 (now OWL1009)
Co-Requisites: None
Compulsory Element: Students must achieve an overall mark of 40% in the module to pass
Course Contents:

This module explores a number of themes which include: managing human resources; trends in human resource management; providing equal employment opportunity and a safe workplace; recruiting human resources; selecting employees and placing them in appropriate jobs; training employees; managing employee performance and pay; providing employee benefits; collective bargaining and labour relations; managing human resources globally.

Supplementary Notes: This module may only be taken as part of an approved degree programme.

Learning Outcomes

At the end of the module, students should be able to analyse and evaluate the role, responsibilities and functions of human resource management in today's organisations and the challenges human resource managers face. Students should also be able to understand and appreciate the ethical issues in human resource management and to critique not only how human resource management contributes to an organisation's performance, but also the types of skills needed for effective human resource management.

Skills: The module aims to develop the intellectual and practical skills of the student in acquiring, analysing, interpreting, and understanding current human resource management issues by introducing them to the theoretical concepts and principles underpinning the effective management of human resources in a variety of organisational contexts. Students will be encouraged to work independently and in groups to improve their own learning and to provide solutions to human resource problems.

MGT2019 (OWL2019) Leading For Change

Course Detail
Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Components: Lecture Required, Seminar Required
Assessment: Coursework 40%, Paper 60%
Pre-Requisites: **MGT1009/OWL1009 (new code)**
Co-Requisites: None
Compulsory Element: Students must achieve an overall mark of 40% in the module to pass
Course Contents
The module uses contemporary theories and models of leadership in organization to study how leaders influence organizational effectiveness. Students will lean to apply the theoretical perspectives or models to study how leaders develop future vision, and how they motivate, manage and change people and organization to achieve the vision. The module will provide a wide knowledge on a number of major perspectives on organizational leadership. These perspectives include leadership behaviours, leading and managing organizational change, contingency theories of effective leadership, leading teams, ethical practices, transformational leadership, leading cross-cultural activities, strategic leadership and leadership development.
Supplementary Notes: This module can only be taken as part of an approved degree programme.
Learning Outcomes:
Successful completion of the module will enable students to:

1. Analyse and apply the theories and models that underpin organizational leadership
2. Demonstrate a critical understanding of how managers establish relationship with peers, and manage and motivate the performance of their subordinates
3. Understand the role of leaders in shaping and changing organizational structure and culture.
4. Explore how leaders develop an organization's future vision and achieve it by aligning the organization and motivating people.
5. Apply different leadership and decision making strategies to achieve superior organizational performance.

Skills:
The module aims to provide a theoretical and practical understanding of the core characteristics associated with leadership, and its effect on contemporary business situations. It will also provide an opportunity for students to develop leadership and management skills.

MGT2027 (ITAO2027) – Contemporary Operations Management

Course Detail
Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Components: Lecture Required, Practical Required, Seminar Required
Assessment: Continual Assessment 40%, Paper 60%
Pre-Requisites: None
Co-Requisites: None
Compulsory Element: Students must achieve an overall mark of 40% in the module to pass
Course Contents:
This course develops the major themes of Operations Management within both manufacturing and service organisations. The primary objective is to familiarise students with the basic concepts, techniques, methods and applications of operations management. Topics include operations strategy and performance, strategic, tactical, and operational decisions and corresponding decision support tools, capacity management, quality management and use of new technologies. Contemporary manufacturing philosophies and trends such as Sustainable manufacturing, 3D

printing/additive manufacturing, Lean Production, supply chain management and risk/failures analysis and management, Industry 4.0 will also be covered.
Supplementary Notes: This module may only be taken if specified on an approved degree programme.
Learning Outcomes:
This module is designed to give the learner practical and theoretical knowledge of the intricacies of operations management and its link with the organisation's overall competitiveness.
At the end of the module, students should acquire knowledge and understanding of:

- Contemporary issues that impact managing operations, as well as new manufacturing trends, tools and technologies.
- Operations Management methods and tools and will be able to apply these for solving contemporary operations management and supply chain management issues.
- Relationship between operations and other organisational activities including marketing, human resource management and finance.

Skills:

- Plan, conduct and report a piece of original research;
- Synthesise, analyse and evaluate information from a variety of different sources
- Enhanced communication skills - both written and oral
- Teamwork
- Competent use of information technology (word-processing, PowerPoint, internet searches, subject specific software).

STAGE 3

CSC 3023 - BIT Project

Course Detail
Career: Undergraduate
Units: 40.00
Grading Basis: Graded
Course Components: Lecture Required
Assessment: Project 100%
Pre-Requisites: None
Co-Requisites: None
Compulsory Element: Individual Project, group participation and attendance at supervisory meetings.
Course Contents

- A project requiring the construction of an information technology-based solution to a business-related problem. To include:
  - Software Design: Agile software design (iterative development, agile development principles), User Experience design.
  - User Acceptance Testing.
  - Web app development that could be deployed to mobile/tablet.

Supplementary Notes: None
Learning Outcomes: Be able to

- Apply appropriate commercial and economic strategies to produce an IT system for a business-related problem through the use and maintenance of information systems.
- Select and assess user, task and technical requirements and tests for a given application.
- Design and develop appropriate user interfaces tailored to a domain specific application for a specific user population.
- Design and develop a web-based front-end and a databases back-end in fulfilment of user requirements.
- Demonstrate a range of project management skills including those relating to the management of cost, quality, human-resource, communication and risk through the development of a project plan and the use of strategic planning.

Skills:
KNOWLEDGE & UNDERSTANDING: Understand project management techniques and requirement analysis techniques.
INTELLECTUAL: Problem solving skills using IT skills and system design skills.
PRACTICAL: Selection and application of appropriate IT tools, application of system design and implementation techniques, delivery of a system on time, reliably and to specification.

CSC 3062 - Data Analysis and Visualisation

Course Detail
Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Components: Lecture Required, Practical Required
Assessment: Coursework 100%
Pre-Requisites: None
Co-Requisites: None
Compulsory Element: None

Course Contents

- How Data Analytics is used in industry and research
- Obtaining data
- Cleaning and converting data into a form to make it suitable for analysis and visualisation
- Use of existing tools to visualise data
- Use of existing tools to identify statistical patterns
- Formulating and testing theories about data
- Communicating data analytic discoveries effectively

Supplementary Notes: Project is developed in stages throughout the module (not submitted in stages)

Learning Outcomes: Be able to:

- Explain how data analytics is used in industry and research.
- Demonstrate the ability to obtain, process and clean data for analysis.
- Use existing tools to visualise and analyse data.
- Formulate and test theories about data.
- Communicate discoveries effectively.

Skills: Creativity in obtaining useful data. Ability to use techniques to clean and process data. Ability to use existing tools for analysis and visualisation of data. Creativity and reasoning skills required to formulate theories about data and to evaluate those theories using statistical analysis of the data. Communicating theories about data in a clear way. Demonstrating patterns in data in a convincing way.

CSC 3064 - Network Security

Course Detail

Career: Undergraduate

Units: 20.00

Grading Basis: Graded

Course Components: Lecture Required, Practical Required

Assessment: Coursework 100%

Pre-Requisites: None

Co-Requisites: None

Compulsory Element: None

Course Contents:

Introduction to Network Security:

- Key concepts & principles
- Attack Types, Threats, vulnerabilities in Internet Protocols.
- Firewalls, Access Control and Traffic Filtering
- Intrusion Detection and Prevention Systems
- Secure Network Architecture
- Internet Security Protocols

Supplementary Notes: None

Learning Outcomes: A successful student will:

- Know and understand the administration of network security
- Know and understand the technologies involved in the design and deployment of secure networks
- Be able to demonstrate the use of tools for network security analysis, Firewalls etc

Skills: This module provides an opportunity to exercise aspects of the following QCA Key Skills (at proficiency Level 4): Communication, ICT, Improving Own Learning and Performance, and Problem Solving

ISY3008 (ITAO3008) – Information Systems in Organisations

Course Detail
Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Components: Lecture Required, Tutorial Required
Assessment: Presentation 30%, Report 70%
Pre-Requisites: None
Co-Requisites: None
Compulsory Element: Students must achieve an overall mark of 40% in the module to pass
Course Contents
Traditional Vs modern role of technology, Strategic Information Systems (SIS) and Competitive Strategies, strategic planning for IS & IS strategy, integration of IS with business objectives, Internet & strategy, Inter-organisational Information Systems and E-commerce, Culture & Management of technological change, Business Process Re-engineering and Business Transformation, and outsourcing/geosourcing
Supplementary Notes: This module may only be taken if specified on an approved Degree programme
Learning Outcomes
At the end of this module students will be able to:

1. Explain the current role of IS in organisations and, use tools/frameworks confidently to identify and exploit the operational and strategic potential of IS for business advantage;
2. Discuss how IS can be used to, build inter organisational relationships (including e-commerce) and, reengineer business processes;
3. Develop strategic plans for the effective use of IS including outsourcing and explain how to establish symbiosis between business objectives and IS strategy.
4. Articulate the importance of a robust strategy in the internet age
5. Explain the role of culture &other issues in the management of technological change
6. Critically analyse and solve real world IS based business problems.

Skills: Work and learn independently, problem solving/critical thinking, communication skills, IT skills, work in teams

MGT3011 (IBEM3011)– Innovation Management

Course Detail
Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Components: Lecture Required, Seminar Required
Assessment: Coursework 35%, Essay 65%
Pre-Requisites: None
Co-Requisites: None
Compulsory Element: Students must achieve an overall mark of 40% in the module to pass
Course Contents
Successful innovation at the firm level is increasingly regarded as key to both productivity growth and enhanced competitiveness while also acting as a driver of economic growth. Innovation is considered crucial for firms' survival while research has further demonstrated that innovating firms grow faster, have higher productivity and are more profitable than non-innovators. Innovation is, however, an uncertain process and the strategies and processes associated with innovation require a specific set of resources, skills and competencies. Generally, most firms do not have well developed or professionally managed innovation strategies and as a result, they fail to innovate and create new value. This module demonstrates the strategic imperative for innovation and analyses the innovation management function.
This module provides an integrative view of the management of innovation, comprising industrial, organisational and managerial perspectives. In doing so, it aims to critically evaluate the main

concepts, measures and indicators of innovation activity and to assess the importance of innovation to both individual businesses and the wider economy.

Supplementary Notes

This module may only be taken if included as a named elective on a programme specification on an approved Degree pathway.

Learning Outcomes

At the end of this module students should be able to:

- Explain and critically reflect on innovation and why it is crucial to competitive advantage and organisational success.
- Conceptualise and critically explore the context and process of innovation management.
- Analyse innovation management in a variety of organisations using examples from the world's most innovative firms.
- Critically evaluate innovation management and provide recommendations for change demonstrating appropriate judgement

Skills

In addition to the above this module provides opportunities for the student to develop the following cognitive and transferrable skills:

- Ability to synthesise, analyse, interpret and evaluate information from a variety of different sources (academic literature, lecture material, quantitative and qualitative business and market information, government publications, web-sites, bibliographic searches).
- Ability to apply critical thinking skills to a variety of different situations (through case study material, problem solving tasks).
- Ability to apply conceptual and empirical tools to business scenarios and use appropriate techniques to present and analyse company data.
- Effective communication (through essay writing, podcast creation and group discussion).

MGT3012 (OWL3012) – Business Ethics

Course Detail

Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Components: Lecture Required, Seminar Required
Assessment: Case Study 60%, Presentation 40%
Pre-Requisites: None
Co-Requisites: None
Compulsory Element: Students must achieve an overall mark of 40% in the module to pass

Course Contents

This module on Business Ethics discusses and evaluates the ethical responsibilities of managers and organisations. It will explore themes/issues from multi-disciplinary and managerial perspectives and analyse tensions, conflicts, contradictions and dilemmas via case studies and class discussion. Topics that may be developed include: the role of ethical theories, the internal ethical environment (why and how do ethical dilemmas arise and how can they be resolved?); ethical issues with regard to employees (including whistleblowing, Codes of Ethics, corporate governance), ethics and consumers, ethics and social responsibility.

Supplementary Notes

This module may only be taken if specified on an approved degree programme.

Learning Outcomes

By the end of the module, students should be able to: Evaluate the ethical responsibilities of organisations. Critique the core concepts of ethical thinking and ethical management practice. Evaluate the role of ethics in business, in local, national and international contexts. Analyse different ethical perspectives and theories that are used to guide decision making. Evaluate the rights, duties and responsibilities of, and relationships between, organisations and their internal (employee) and external stakeholders (customers, local and wider communities). Assess the relationship between business ethics and corporate social responsibility.

Skills
Synthesise, analyse, interpret and evaluate information from a variety of different sources. Apply critical thinking skills to a variety of different situations (through case study material, analysis of relevant policies and approaches, problem solving tasks). Plan, conduct and report a piece of original research (for continuous assessment). Communicate effectively (through essay writing, report writing and presentations). Work effectively as an individual and as part of a team (tutorial work, continuous assessment). Competent use of information technology.

MGT3013 (ITAO3013) – Supply Chain Management

Course Detail
Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Components: Lecture Required, Seminar Required
Assessment: Coursework 60%, Coursework 40%
Pre-Requisites: None
Co-Requisites: None
Compulsory Element: Students must achieve an overall mark of 40% in the module to pass
Course Contents
Themes include: Introduction to Supply Chain Networks; Lean and Agile Supply Chain approaches; Demand Management; Supply Management; Inventory Management; Supplier Selection and Assessment; Supplier Relationship Management; Supplier Development and Involvement; Supply Chain Risk Management; Sustainable Supply Chain Management.
Supplementary Notes
Students may only take this module as part of an approved degree programme
Learning Outcomes
On completion of the module students will:

- Understand the nature, scope and role of supply chain management in (and between) organisations.
- Be able to identify and discuss the key issues that face supply chain managers as they make decisions.
- Be able to understand and discuss the key concepts and theories involved in supply chain management.
- Understand the importance of co-operative practices in supply chain activities and ways in which such practices may be achieved.
- Have identified, reviewed and evaluated a specific topic on a contemporary supply chain management related issue.

Skills:
The module is also designed so that students may enhance/develop the following skills and/or competencies (mainly through tutorial activities):

- Team-working: ability to work in groups to discuss key concepts, provide solutions and develop key business-related interpersonal skills.
- Analytical: ability to synthesise material and provide critical commentary.
- Research skills: ability to formulate research questions, implement strategies for data gathering and present key findings.
- Presentation and communication skills: written, oral as well as developing confidence in public speaking and addressing peers.

MGT3018 (OWL3018) – Public Sector Management

Course Detail
Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Components: Lecture Required, Seminar Required
Assessment: Essay 1 40%, Essay 2 60%
Pre-Requisites: None
Co-Requisites: None
Compulsory Element: Students must achieve an overall mark of 40% in the module to pass
Course Contents
There can be little doubt that many changes have taken place in the way the public sector of the late 1990s and early 2000s has been managed. It is dominated by many underlying themes such as value-for-money, accountability, doing-more-with-less, customer focus and electronic government. This module attempts to unravel these key themes and discuss their importance to public sector management.
Supplementary Notes
This module may only be taken if specified on an approved degree programme.
Learning Outcomes
To develop the intellectual and practical skills of the learner in the acquisition, analysis and interpretation and understanding of current issues relevant to managing in the public sector.
Skills
Intellectual (thinking skills): - planning, conducting and writing reports; synthesising, analysing and interpreting information.
Transferable skills: - individual and group work; oral and written communication; competent use of Information Technology; personal and interpersonal skills.

MGT3019 (IBEM3019) – Strategic Management

Course Detail
Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Components: Lecture Required, Seminar Required
Assessment: Assignment 1 25%, Continual Assessment 75%
Pre-Requisites: None
Co-Requisites: None
Compulsory Element: Students must achieve an overall mark of 40% in the module to pass.
Course Contents
Students will develop an understanding of Strategy and Strategic Management in various contexts. The module will evaluate various theoretical models underpinning strategic management concepts. It will also address more practical issues such as strategic planning, strategic choice and strategic options (including acquisitions, divestments, strategic alliances, growth and retrenchment strategies).
Supplementary Notes: This module can only be taken as part of an approved degree programme.
Learning Outcomes:

- Evaluate strategic priorities at corporate, business and operational levels. Analyse and evaluate the strategic management process.
- Have a clear understanding of a range of Strategic Analytical Tools and be able to apply these in different contexts
- Analyse and evaluate the theoretical aspects Strategic Choice Theory
- By the end of the module students should be able to analyse and evaluate the theoretical and practical issues associated with developing strategy in various contexts, including strategy in a small business environment and strategy in the third sector.

Skills:

- Knowledge acquisition and development skills.
- Critical reflection and analysis
- Synthesis of knowledge & Writing skills
- Problem solving skills

MGT3034 (IBEM3034) – Contemporary and Emergency Issues in Business and Management

Course Detail
Career: Undergraduate
Units: 20.00
Grading Basis: Graded
Course Components: Lecture Required, Seminar Required
Assessment: Continual Assessment 35%, Paper 65%
Pre-Requisites: MGT1009 (now OWL1009) Organistional Behaviour
Co-Requisites: None
Compulsory Element: Students must achieve an overall mark of 40% in the module to pass
Course Contents
In today's rapidly changing and uncertain business environment, business leaders and managers need to be aware of emerging trends and issues and how these might impact the organisation both strategically and operationally.
This module allows students to explore a range of contemporary and emerging issues under the broad umbrella of grand challenges and wicked problems. Thus, macro level and emerging global 'issues' such as those relating to, for example, to the United Nations' Sustainable Development Goals (SDGs), modern day slavery, and (de)industrialisation may be discussed.
Changing trends in consumer behaviour, the role and impact of working with diverse stakeholders will also be addressed.
Given the uncertainty and operating in VUCA environments, topics such as organisational resilience and diversity will also be explored.
Attention will also be given to local and national issues and their impact (both positive and negative) on the internal business environment.
Supplementary Notes: Only students who are registered in the following programmes of study, can complete this module: Business Management, International Business with a Language, Business Economics and Business Information Technology
Learning Outcomes: Upon successful completion of the module students should be able to:

- Critically evaluate the role and meaning of grand challenges and wicked problems as applied to business and management
- Critically evaluate a range of contemporary and emerging issues in business and management nationally and internationally
- Analyse the potential (and actual) impact of these issues in a range of business environments
- Demonstrate knowledge and understanding of a range of relevant management theory and its application to contemporary and emerging issues in business and management.

Skills:

- Critically evaluate information and its veracity in relation to the role and impact of emerging 'issues' in business and management
- Apply logic and reasoning to scenario based situations and problem solving
- Communicate ideas, critique theoretical frameworks and discuss their strengths and shortcomings in a range of business environments. Communication will be in both written and presentational forms
- Use ICT software effectively
- Work both independently (summative assessment) and in groups (formative assessment)
- Manage own time and workloads effectively
- Pursue independent enquiry