MQF Level 6

Bachelor of Engineering (Honours) in Electronics and Control Engineering

EE6-06-21

Course Description

The aim of this degree is to develop professional engineers who are both academically prepared and practically trained to satisfy the requirements of local industry. Moreover, graduates from this course will be suitably prepared to embark on careers or further their studies.

Control engineering is, from many perspectives, at the peak of the various engineering disciplines. Indeed, many engineering problems involve the processing of information of some form in order to control some system or variable within a more complex system. Giving students a good preparation in control engineering increases their attractiveness to industry.

Programme Learning Outcomes

At the end of the programme the learner will be able to:

1. *Design and implement hardware and firmware for embedded systems applications;*
2. *Analyse and design complex electronic control systems for various engineering applications;*
3. *Manage projects involving the installation and maintenance of engineering systems;*
4. *Contribute to the development of research projects in the field of electronics and control engineering.*

Entry Requirements

MCAST Advanced Diploma in Industrial Electronics

or

MCAST Advanced Diploma in Electrical Systems

or

MCAST Undergraduate Diploma in Foundations of Engineering

or

2 A-Level passes and 2 I-Level passes Compulsory A-Levels: Physics, Mathematics (Pure or Applied) Applicants need to obtain an average Grade C or better across their A-Levels in Mathematics and Physics (such as Grades C, C; Grades B, D; Grades A, E),

or

a related MCAST Advanced Diploma (with an overall mark of 60% or higher).

Current Approved Programme Structure

Unit Code	Unit Title	ECTS	Year
ETMTH-606-1901	Engineering Mathematics 1	6	1
ETELE-606-1903	Digital Electronics 1	6	1
ETSFT-606-1900	Programming Techniques	6	1
ETENG-606-1910	Physics for Engineers	6	1
ETMEC-606-1901	Mechanical and Thermo-fluid Principles	6	1
ETMTH-606-1902	Engineering Mathematics 2	6	1
ETE&E-606-1901	Electrical and Electronic Principles	6	1
ETELE-606-1904	Analogue Electronics 1	6	1
ETELE-606-1905	Microcontrollers 1	6	1
CDKSK-604-1909	Entrepreneurship	4	1
CDKSK-602-2105	Community Social Responsibility	2	1
ETMTH-606-1903	Engineering Mathematics 3	6	2
ETELE-606-1906	Analogue Electronics 2	6	2
ETELE-606-1907	Further Electrical Principles	6	2
ETSFT-606-1901	Data Structures and Algorithms	6	2
ETELE-606-1908	Microcontrollers 2	6	2
ETMTH-606-1904	Engineering Mathematics 4	6	2
ETPRJ-606-1901	Engineering Project - Group	6	2
ETENG-606-1911	Plant and Process Control	6	2
ETELX-606-1901	Power Electronics Devices and Circuits	6	2
ETELE-606-1909	Digital Electronics 2	6	2
ETELX-606-1532	Signals and Systems	6	3
ETSFT-606-1802	Software Design and Analysis	6	3
ETELX-606-1812	Analogue Electronics 3	6	3
ETELX-606-1529	Control System Theory	6	3
ETELX-606-1813	Programmable Logic Controllers	6	3
ETELX-606-1530	Digital Signal Processing	6	3
ETELX-606-1814	Microcontrollers 3	6	3
ETRBS-606-1801	Robotics	6	3
ETELE-606-1816	Electrical Machines	6	3
ETCRL-606-1501	Practical Control Engineering	6	3
ETMTH-606-1806	Engineering Mathematics 5	6	4
ETELE-606-1813	Advanced Power Converters	6	4
ETELX-606-1815	Analogue Electronics 4	6	4
ETCRL-606-1502	Advanced Digital Control Principles	6	4
ETRSH-600-1502	Research Methods	0	4
ETMGT-606-1507	Strategic Management	6	4
ETELX-606-1816	Microcontrollers 4	6	4
ETELX-606-1817	Motor Drive Applications	6	4
ETQLS-606-1501	Quality Assurance	6	4
ETDIS-612-1501	Dissertation	12	4
	Total ECTS	**240**	**/**

Unit: ETMTH-606-1901 - Engineering Mathematics 1

Unit level (MQF): 6

Credits: 6

Unit Description

This unit prepares the learners to develop a solid theoretical mathematical basis and the skills to solve engineering problems. It is an essential basis for the successful completion of many of the other units within the qualification.

A prerequisite qualification for this unit is the minimum standard of proficiency at level 4 algebra. This includes the mathematical fundamentals of laws of algebra, manipulation and transposition of formulae, algebraic operations, linear, quadratic and simultaneous equations; and the laws of indices and logarithms.

Learners develop their knowledge, understanding and problem solving skills, in algebraic methods and techniques, partial fractions, arithmetic and geometric progressions, trigonometry including graphs, trigonometric equations, using and simplifying trigonometric identities. Higher level problems are set in an engineering context. The unit also covers areas of calculus, with the focus being on a vast range of Differentiation and Integration techniques, again in engineering and practical situations. Problem solving is also developed in using and working with Complex Numbers and Functions and their transformation since these are very relevant to a good basis for competence in this subject.

This unit is relevant to learners, wishing to develop their engineering mathematics skills further since it is the first of a series of five Engineering Mathematics Units.

Learning Outcomes

On completion of this unit the student will be able to:

1. *Apply algebraic techniques to manipulate expressions and solve problems;*
2. *Recognise and analyse trigonometric graphs and resolve problems in engineering context;*
3. *Use differentiation and integration techniques and resolve problems in an engineering context;*
4. *Solve problems using complex numbers;*
5. *Apply functions and transformations.*

Unit: ETELE-606-1903 - Digital Electronics 1

Unit level (MQF): 6

Credits: 6

Unit Description

Digital technology forms the backbone of our technological society. Digital technology is present in the form of microprocessors and ASIC technology is found everywhere. An engineering student needs a solid introduction to the formal logic underpinning digital electronics especially as digital design is becoming more abstract. This unit focuses on the fundamental principles of Boolean logic theory and binary arithmetic, continuing with combinational logic structures.

The student is introduced to the design of combinational logic functions and how these may be combined together to form more complex functions. Basic computational structures are also introductory together with performance evaluations. Synchronous sequential logic is the backbone of every digital system. Together with state machine theory complex logic function maybe designed. Apart from state machine theory sequential logic blocks such as counters and shift registers are also covered both in an analytical and design function.

This unit focuses on design using discrete devices as well as interfacing to external circuitry. Highly structured devices such as PAL and EEPROMS are covered to layout the foundations for CPLD and FPGA development in further units. Practical sessions are used to supplement the theoretical foundations done in class.

This unit is a perquisite to *'Digital Electronics 2'*.

Learning Outcomes

On completion of this unit the student will be able to:

1. *Understand and apply logic gates and Boolean logic theory;*
2. *Investigate functional blocks designed using combinational logic;*
3. *Understand Sequential Logic theory and analyse sequential functions;*
4. *Appraise logic families and recognize the need for Interfacing in logic circuits.*

Unit: ETSFT-606-1900 - Programming Techniques

Unit level (MQF): 6

Credits: 6

Unit Description

No previous programming experience is assumed and so the unit is particularly relevant to learners wanting to gain a sound insight into the fundamentals of programming within the context of an engineering framework.

This is a skills based unit, which will enable learners to gain proficiency in designing, implementing, and testing computer programs. Central to the unit is the use of structured design techniques, which enable key aspects of program development to be carried out within an engineering framework. Learners are introduced to numerical computations by having the opportunity to implement some methods learnt in other units. An introduction to data structures and subsequent using arrays is also presented.

This module is a perquisite to the *'Data structures and algorithms'* module.

Learning Outcomes

On completion of this unit the student will be able to:

1. *Apply the C programming language to design solutions;*
2. *Solve applied Engineering problems in C;*
3. *Manage development through testing and debugging techniques;*
4. *Implement array based data structures and operations.*

Unit: ETENG-606-1910 - Physics for Engineers

Unit level (MQF): 6

Credits: 6

Unit Description

Engineers need to have a solid grasp of the fundamental physical processes in order to be able to provide solutions to everyday situations. Field theory and electron physics provide the fundamental concepts of electrical engineering and semiconductor theory. With the proliferation of wireless devices and increasing frequency of operation of semiconductor devices an introduction to wave theory especially electromagnetic wave is indispensable for subsequent units.

This unit provides the theoretical underpinnings for *'Analog Electronics 1'* and '*Electrical and Electronic Principles*'.

Learning Outcomes

On completion of this unit the student will be able to:

1. *Investigate the properties of electrostatics and capacitors;*
2. *Illustrate the properties of magnetic fields and inductors;*
3. *Understand electromagnetic induction and motors;*
4. *Understand the properties of electrons and waves.*

Unit: ETMEC-606-1901 - Mechanical and Thermo-Fluid Principles

Unit level (MQF): 6

Credits: 6

Unit Description

This unit aims to provide learners in the electrical / electronics field an introduction to mechanical engineering principles and fluid thermodynamic processes. The unit is made up of two sections: the theory of engineering mechanics and the theory of thermo-fluids. No prior knowledge of the subject is required; however, a solid basis of mathematics is required.

The first part of the unit is a theory based section where learners will be introduced to engineering statics and will familiarize with the analysis of slender members such as beams, columns, and circular shafts. Following this, learners will then be introduced to engineering dynamics and engineering problems with uniform acceleration. The principle of conservation of energy and energy transfer in systems are also tackled.

Learners are then introduced to the principles behind hydraulic systems and gravity-based pressure measurement instruments. The learner will also be able to apply theoretical knowledge to solve simple one dimensional fluid flow problems. Learners will be able to apply the principles of dimensional analysis and calculate the head loss in pipe systems: define the Reynolds number of fluid flow, identify the velocity flow profile and pipe friction losses for laminar/turbulent flow and evaluate pipe secondary losses. Learners will also be introduced to definition of drag and lift forces of flows past immersed bodies.

Learning Outcomes

On completion of this unit the student will be able to:

1. *Determine the behaviour of mechanical static systems.;*
2. *Determine the behaviour of mechanical dynamic systems;*
3. *Interpret and determine the thermodynamic properties of a fluid undergoing thermodynamic cycles;*
4. *Evaluate hydrostatic and fluid flow systems.*

Unit: ETMTH-606-1902 - Engineering Mathematics 2

Unit level (MQF): 6

Credits: 6

Unit Description

This unit was designed to build upon previous theoretical mathematical knowledge covered in Engineering Mathematics 1, to be used in a practical engineering context. The learner is assumed to have successfully completed Engineering Mathematics 1 prior to commencing this unit.

Furthermore, it acts as an essential basis for the successful completion of many of the other units within the qualification. This unit provides the knowledge and understanding and problem solving skills to use graphical and numerical methods to solve engineering problems. Since this involves use of graphs curve sketching techniques are explored.

The unit covers also areas of Statistical techniques and Probability, Linear correlation and regression, focus on use of Normal distribution, to solve problems in an engineering context.

Problem solving is developed in expanding further previous calculus skills and includes first and second order linear differential equations, Euler and Euler's improved methods and applying these techniques to engineering problems. Use of power series methods and Laplace transforms techniques are developed to solve a range of differential equations. A high competence in this area is essential and very relevant to other engineering subjects.

The Unit is relevant to learners wishing to further develop their engineering mathematics skills, and is the second of a series of five mathematics units.

Learning Outcomes

On completion of this unit the student will be able to:

1. *Use graphical and numerical methods to solve problems;*
2. *Use statistical and probability techniques to resolve engineering problems;*
3. *Analyse and resolve problems using differential equations;*
4. *Use and apply Laplace Transforms to model and resolve engineering problems.*

Unit: ETE&E-606-1901 - Electrical and Electronic Principles

Unit level (MQF): 6

Credits: 6

Unit Description

This unit introduces the learner to the theory of electrical circuits used in a range of other engineering units and provides the basis for further study of more specialist areas of electrical and electronic engineering. A prerequisite for this is the Engineering Mathematics 1 unit.

This unit develops from the basic principles of dc and ac circuit theory. The learner is introduced to d.c. theory, electrical principles and the relevant laws being applied to series and parallel circuits and networks. Then the unit introduces single-phase a.c. circuit theory and its application to series and parallel RLC circuits. Circuit and Transformation theorems such as Norton's, Thevenin's and Superposition analysis are applied to d.c. and a.c. networks.

More complex circuit theory is introduced with Complex waveforms, their properties and a subsequent detailed investigation using Fourier Series analysis.

The learner is finally introduced to transient analysis, performed using Laplace Transforms to circuit response of first and second order RLC series and parallel circuits and networks.

Learning Outcomes

On completion of this unit the student will be able to:

1. *Apply d.c. and a.c. circuit theory to series and parallel networks;*
2. *Use circuit and transformation theorems to resolve problems in networks;*
3. *Investigate the properties of complex waves using Fourier analysis;*
4. *Investigate circuit response using transient analysis and Laplace transforms.*

Unit: ETELE-606-1904 - Analogue Electronics 1

Unit level (MQF): 6

Credits: 6

Unit Description

Though there is a substantial shift towards digital technology and processes analogue electronics retains a fundamental role in circuit design. This course provides that underpinning theory of semiconductor devices, starting the pn junction and progressing to the operation of the Bipolar Junction Transistor (BJT). The characteristics and modelling of the BJT are discussed together with different biasing techniques. Negative feedback is introduced through the analysis of the basic operational amplifier circuits and the discussion of its application the discrete amplifier. Given the ever-increasing complexity of integrated circuits, simulation plays a critical role in determining the correct functionality of a circuit. The students are also introduced to different circuit prototyping techniques both using through hole and surface mount devices.

Students reading this unit should have successfully completed the unit *'Physics for Engineers'*. This unit is a perquisite to *'Analogue Electronics 2'*.

Learning Outcomes

On completion of this unit the student will be able to:

1. *Understand the fundamentals of semiconductor theory, the pn junction and diode applications;*
2. *Understand the construction and operation of the Bipolar Junction Transistor;*
3. *Recognize various applications of operational amplifiers;*
4. *Perform circuit simulation as functional verification, use instruments to verify operation and investigate various circuit construction techniques.*

Unit: ETELE-606-1905 - Microcontrollers 1

Unit level (MQF): 6

Credits: 6

Unit Description

Microprocessors are everywhere, providing 'intelligence' in cars, mobile phones, medical - an endless list. This unit is relevant to learners wishing to develop their understanding of the overall organization of a microprocessor-based system, details the characteristics of a microcontroller and embedded system, classifies memory technologies according to their volatility and provides an overview of the microcontroller market. Learners will have the opportunity to become familiar with various 8-bit, 16-bit and 32-bit microcontroller families, discuss the memory space in a microcontroller based system and CPU registers, and examine the various addressing modes and ARM instruction set. Additionally, students will be introduced to the basic assembly language programming skills such as arithmetic operations, program loops, data shifting and time delay creations.

The learner will also be able to use embedded IDE (Integrated Development Environment) to write the embedded code using low-level and high-level language compilers and the use of simulation tools to test and debug small-scaled embedded systems which interface and use I/O devices such as LED and LCD displays, switches, stepper motors, sensors, DC and Servo motors. It is being assumed that as prerequisite the learner has taken a course on digital logic design and has been exposed to at least one high-level language (preferably C) programming. Knowledge of digital logic design will greatly facilitate learning of the unit content. Knowledge of assembly language is not required.

Learning Outcomes

On completion of this unit the student will be able to:

1. *Evaluate the architecture and characteristics of a microprocessor or microcontroller based system;*
2. *Use of an embedded IDE to write, debug and test assembly programs;*
3. *Develop embedded C programs to fulfil a specific application;*
4. *Demonstrate the ability to design and build a working small-scaled microcontroller system using a range of I/O devices.*

Unit: ETMTH-606-1903 - Engineering Mathematics 3

Unit level (MQF): 6

Credits: 6

Unit Description

This unit has been designed to build upon the previous theoretical mathematical knowledge, understanding and problem-solving skills covered in Engineering Mathematics 1 and Engineering Mathematics 2. It is to be used in a practical engineering context. The learner is assumed to have successfully completed Engineering Mathematics 1 and Engineering Mathematics 2 prior to commencing this unit.

Furthermore, this unit are an essential basis for the successful completion of many of the other units within the qualification.

This unit provides the knowledge and understanding and problem solving skills to use and manipulate Matrices and Vectors to solve problems in an engineering context.

Problem solving is further developed using techniques in Calculus to solve partial differential equations in applications in an engineering scenario. Fourier series is explored in depth to analyse, model and solve engineering problems. A high competence in this area is essential and very relevant to other engineering subjects.

The Unit is relevant to learners wishing to further develop their engineering mathematics skills, and is the third of a series of five mathematics units.

Learning Outcomes

On completion of this unit the student will be able to:

1. *Use and apply matrices and resolve problems in engineering context;*
2. *Apply vector analysis and resolve problems in an engineering context;*
3. *Be able to analyse, model and resolve Fourier Series problems in an engineering context;*
4. *Be able to analyse, model and resolve partial differential equations in engineering situations.*

Unit: ETELE-606-1906 - Analogue Electronics 2

Unit level (MQF): 6

Credits: 6

Unit Description

The previous unit introduced semiconductor theory as the basis for solid state devices as well as the operational amplifier. The properties of solid state devices are further enhanced through the use of negative feedback. The unit starts with discussing the major family of discrete devices, the Field Effect Transistor (FET). Negative feedback is than discussed in the context of op-amp based circuits and a range of linear circuits are discussed. Linear have their own limitations and when paired with discrete devices the overall performance is enhanced. A learning outcome has been devoted to the application of negative feedback in discrete circuits. Students would be able to calculate the properties with negative feedback applied and appraise its use.

Mixed signal design is becoming standard practice, hence the analogue-digital interface and vice-versa have become critical system parameters. The unit closes by discussing the architecture and operations of this class of devices. The unit Microcontrollers 2 applied mixed signal interfacing to embedded systems.

In the delivery of this unit an emphasis is placed on the practical component and familiarizing students with the operation of standard linear circuit topologies.

Learning Outcomes

On completion of this unit the student will be able to:

1. *Understand the operation of Field Effect Transistors and various circuit configurations;*
2. *Understand and apply feedback theory and linear circuits;*
3. *Apply feedback theory to circuits containing discrete devices;*
4. *Understand the principles of operation and interface to Analog to Digital Convertors (ADC) and Digital to Analog Convertors (DAC).*

Unit: ETELE-606-1907 - Further Electrical Principles

Unit level (MQF): 6

Credits: 6

Unit Description

This unit covers more specialised topics in electrical principles that learners will need to understand and apply in many areas of electrical and electronic engineering. It builds on the unit of Electrical and Electronic Principles.

Advanced circuit and transformations theorems will be applied as well as maximum power transfer to electrical circuits and networks and magnetically coupled circuits including transformers. Two port networks, characteristic impedance and attenuators will be investigated.

Learners will also study about transmission lines and reflections on them, their parameters and properties including phase delay and velocity of propagation. Learners will be exposed to problems related to the topology of circuits. Solutions to challenging problems involving these topics and in practical context will be explored appraised and justified.

Learning Outcomes

On completion of this unit the student will be able to:

1. *Appraise the use of circuit theory;*
2. *Investigate two-port networks;*
3. *Investigate the operation of transmission lines;*
4. *Investigate the analysis of circuit topology.*

Unit: ETSFT-606-1901 - Data Structures and Algorithms

Unit level (MQF): 6

Credits: 6

Unit Description

As software becomes more adapt in capturing the behaviour of the real world object oriented techniques becomes vital in managing the complexity. Good programming techniques require detailed knowledge of data structures, advantages, disadvantages and implementation details.

Operations on data structures are of major importance in order to process data in an effective manner. The unit begin with a detailed overview of object oriented techniques. C++ is chosen as an implementation language. Familiarity with C is assumed and only the extra C++ syntax is presented. A range of data structures is presented together with the principles of dynamic memory management. Finally searching and sorting algorithms together with their complexities are covering.

This unit is preceded by *'Programming techniques'* and is a perquisite to the unit *'Software Design and Analysis'*.

Learning Outcomes

On completion of this unit the student will be able to:

1. *Practice the fundamentals of object-oriented software development;*
2. *Recognize and implement a range of data structures;*
3. *Apply and evaluate different types of tree searching algorithms;*
4. *Apply and evaluate sorting algorithms.*

Unit: ETELE-606-1908 - Microcontrollers 2

Unit level (MQF): 6

Credits: 6

Unit Description

Contrary to classical microprocessors, which are designated for desktop or server computer manufacturing, microcontrollers (MCUs) are primarily designated for the realization of small controller applications, called embedded applications. Nowadays, microcontrollers are embedded everywhere: in cars, TVs, VCRs, high-end stereo systems, monitors, hard disks, keyboards, vacuum cleaners, toasters, and even in children's toys – any battery powered toy contains a microcontroller. Compound devices, in which microcontrollers are integrated together with mechanical or electromechanical hardware, and where microcontrollers manage several control functions, are called embedded systems. The aim of this module is to solidify and build upon a student's previously acquired knowledge of microcontroller systems. The concepts presented in lectures are accompanied with guided hand-on practical sessions so to give learners the opportunity to develop embedded systems, and apply structured software and hardware debugging techniques for various microcontroller based systems.

Students will be guided through a broad range of case studies to develop embedded I/O hardware (operating in both digital and analogue domains) and to incorporate a range of interesting transducers. Attention will also be given to the basic concepts on interrupt programming. It is being assumed that as prerequisite learners following this module should have already taken a course on digital logic design and been exposed to at least one microcontroller system and programming language (preferably C).

Learning Outcomes

On completion of this unit the student will be able to:

1. *Construct and test microcontroller hardware and software to fulfil a control oriented application;*
2. *Develop Memory-mapped IO hardware and software for a specific application;*
3. *Implement interrupt programming for a specific microcontroller application.*

Unit: ETMTH-606-1904 - Engineering Mathematics 4

Unit level (MQF): 6

Credits: 6

Unit Description

This unit prepares the learners to further develop an in depth theoretical mathematical basis while also further develop knowledge and skills required to solve engineering problems.

The aim of this unit is to investigate problems using vector analysis, which is an essential part of an engineer's scientific background. In Linear Algebra, the solutions of Linear Systems of equations are basic concepts that build the basis for other subjects in vector analysis such as differential and integral calculus. The topics covered in this unit include the properties and solution of linear systems of equations, the differential and the integral calculus of vectors together with Stokes' theorem, Green's theorem and the divergence theorem and applications from various fields. Also included are the curvilinear coordinates which prove extremely useful in the solution of problems in advanced engineering, physics and mathematics.

This Unit also prepares the learners, wishing to develop their engineering mathematics skills further since it is the fourth of a series of five Engineering Mathematics Units.

Learning Outcomes

On completion of this unit the student will be able to:

1. *Analyse and solve linear systems of equations using Matrices and Vectors;*
2. *Analyse and appraise solution of problems using Vector Differential calculus;*
3. *Apply and appraise solution of problems using Vector integral calculus and Integration theorems;*
4. *Solve Linear Algebra Problems using Numerical Methods.*

Unit: ETPRJ-606-1901 - Engineering Project - Group

Unit level (MQF): 6

Credits: 6

Unit Description

The majority of engineering projects carried out today are team efforts. The complexity of modern engineering needs the contribution of a number of knowledge domains. Working in team requires extra skills than doing an individual project. It is important that these skills are transferred and honed in an educational environment. Hence the rationale of the group project.

The project lifecycle will be developed in a structured manner under the guidance of a supervisor. The supervisor will provide support and guidance where necessary. Learners will have the opportunity to discuss the division of responsibilities, plan the implementation, testing and subsequent documentation. The project will draw on the skills that have been acquired in other units for successful completion. Each team needs to map the technical and logistical aspects of the project, choose the resources that are required, setup effective communication strategies and keep a log of all the activities done. During the project group members will need to conform to the relevant health and safety legislation.

Supporting the group project there is a number of auxiliary topics. The MATLAB environment has become an essential tool for modelling the operation of electronic systems. The mechanical side of electrical and electronic engineering will be covered through the use Computer Aided Design (CAD) environment. In preparing the student for further study and the dissertation a learning outcome on critical thinking and report writing has been introduced.

The final assessment mark of the project will be split into two parts. There will be mark for the individual work contributed and a second mark which will reflect the team effort in the project. These marks are reflected in the level criteria assessing the project. Each group will consist of 3-4 students. Marks are awarded both for the planning and technical aspect.

Learning Outcomes

On completion of this unit the student will be able to:

1. *Prepare a project specification, plan, design, implement and evaluate a practical solution;*
2. *Read texts in order to evaluate source information and write reports to support argument of an academic and technical nature;*
3. *Apply MATLAB to model engineering systems;*
4. *Use Computer Aided Design (CAD) to design mechanical fixtures;*
5. *Demonstrate theoretical underpinning knowledge of reflective practice in written form and present coherent arguments.*

Unit: ETENG-606-1911 - Plant and Process Control

Unit level (MQF): 6

Credits: 6

Unit Description

This unit introduces the learners to the fundamental principles of Automatic Control Systems by covering basic topics on modelling, analysis and control of linear time-invariant dynamic systems.

The unit is organized into five parts. The first part introduces the subject of automatic control and its most fundamental concepts and terminology via a number of practical examples. The second part covers the Laplace transform, its mathematical properties, and its use in solving linear differential equations. This leads to the third part, which treats mathematical modelling of dynamic systems. This part enables the learner to develop transfer function models for a number of basic engineering systems including electrical, mechanical, thermal and fluid components. The fourth part deals with system analysis, and presents a set of tools for the analysis of linear dynamic systems. These include both time-domain and frequency-domain techniques. The final part of the unit introduces basic linear controller design including phase compensation techniques, Proportional-Integral-Derivative (PID) control, and the Ziegler-Nichols PID tuning rules.

This unit is relevant to learners wishing to acquire a good understanding of the fundamental concepts and the basic tools that are required to maintain or design automatic control systems. Throughout this unit the learners are also exposed to computer simulation tools that are typically employed in the field, as well as a number of practical experiments.

Learning Outcomes

On completion of this unit the student will be able to:

1. *Predict the dynamic and steady state response of an engineering system;*
2. *Design a control system in the time domain to a specified performance requirement;*
3. *Design a control system in the frequency domain to meet a specified performance requirement;*
4. *Understand the need for and use of multi-loop and complex control systems.*

Unit: ETELX-606-1901 - Power Electronics Devices and Circuits

Unit level (MQF): 6

Credits: 6

Unit Description

This unit presents the devices and basic circuits fundamental to power electronics. A review of basic semiconductor devices used for switching is presented along with practical examples for driver circuits required for saturation/cut-off transitions. The operation, derivation of transfer functions and practical implementation of AC-DC and DC-DC conversion circuits is also studied. The unit is aimed at students developing strong design, practical implementation and analytical skills at both component and circuit level. Further power electronic circuits are studied in the module Power Engineering: Advanced Power Converters.

This unit requires as a prerequisite, Physics for Engineers, Analogue Electronics 1 and Electrical and Electronics Principles.

Learning Outcomes

On completion of this unit the student will be able to:

1. *Evaluate the operation of power electronic switching and protection devices;*
2. *Investigate the operation of Rectifier Circuits;*
3. *Investigate the operation of DC-DC Converters;*
4. *Design and Testing of Practical Power Electronic Circuits.*

Unit: ETELE-606-1909 - Digital Electronics 2

Unit level (MQF): 6

Credits: 6

Unit Description

Digital functions have increased in complexity beyond manual design and discrete components. Hence much of digital design is becoming more abstract in the form of High Level Definition Languages and CPLD/FPGA fabric. A detailed introduction to HDL's provides the foundation for sound design practices. In thus unit students are introduced to a number of languages and to structural constructs in VHDL. These constructs enable students to model combinational and sequential building blocks covered in the previous unit. Algorithmic State Machines which form the basis of hardware algorithms are covered and the student is shown methods to convert the ASM charts to hardware structures. Digital circuits need to implemented using either an ASIC or FPGA. Hence the architecture of FPGA and CPLD is covered. The theory presented in this course is supplemented by a number of practical sessions on FPGA boards.

The unit is a perquisite to '*Digital Electronics 3*' and the student needs to have successfully read '*Digital Electronics 1*'.

Learning Outcomes

On completion of this unit the student will be able to:

1. *Understand and design solutions using Algorithmic State Machines;*
2. *Introduction to developing digital systems using Hardware Description Languages;*
3. *Model combinational and sequential circuits;*
4. *Implement digital systems and understand the architecture of CPLDs and FPGAs.*

Unit: ETELX-606-1532 - Signals and Systems

Unit level (MQF): 6

Credits: 6

Unit Description

The need to understand the mathematical properties of signals and the ability to process them whether in the frequency or time domain is at the basis of the fundamental engineering subjects. Typical examples are DSP, Communication, Control and Electronics. A firm grounding in this type of mathematical background is therefore a pre-requisite for the fore-mentioned modules consolidated by applications drawn from filtering, audio and image processing, communications, and automatic control.

The course starts with elementary signals and basic systems. Their fundamental properties, such as causality, time-invariance and linearity are discussed. The behaviour of continuous systems is modelled through differential equations, while the behaviour of discrete systems is modelled using difference equations. The concept of the impulse response and convolution is introduced. The course investigates the Fourier series and transforms, the properties of the Laplace Transform and the Z transform, as well as its use in the frequency domain analysis of the continuous and discrete systems. The concept of State Variables is introduced, followed by methods for solving the matrix State Equations. Finally, the sampling theorem is presented, as an interconnection between the continuous and discrete world.

The purpose of this course is to give students a fundamental knowledge on signals and systems. It is necessary for understanding literature in many engineering fields, such as digital signal processing, image processing, or multimedia processing. Students are to be equipped with the skills of mathematical modelling of discrete and continuous systems, simulating systems on a computer, and to be able to carry out elementary signal processing in the time and frequency domain.

This module is very closely related with the Digital Signal Processing and Control Systems Theory modules. It is essential that coordination and collaboration takes place between and across modules so as to optimize the course to its full holistic value and maximise the learning potential of the learners.

Learning Outcomes

On completion of this unit the student will be able to:

1. *Develop and use mathematical models to analyze signals and solve linear systems;*
2. *Use the four variants of the Fourier transform and be familiar with their properties;*
3. *Determine the frequency response of LTI systems; explain the behaviour of mixed continuous/discrete systems and understand the sampling theorem;*
4. *Use various transform methods to understand the properties and determine the response of linear systems; develop state-space models to solve linear systems.*

Unit: ETSFT-606-1802 - Software Design and Analysis

Unit level (MQF): 6

Credits: 6

Unit Description

The increasing level of complexity of computer managed equipment, as well as the number and complexity of the assignments entrusted to computers, is reflected in a corresponding increase in software size and complexity. This puts enormous pressure on software development as a critical part of system development. The main challenge of software design, today, is to manage software complexity, cost and design time. This leads to the necessity of a structured approach to software design and understanding of underlying processes’ characteristics, methods and tools. It is important to understand methods of discussing requirements and designs at a high level, as well as implementation detail through standardized Unified Modelling Language (UML) notation. A critical part of software development is requirements’ analysis in order to assure that all potential scenarios are foreseen and dealt with in a proper way. Quality designed software should enable effective communication between different parties included in the development process. Finally, although processing power of modern computers is extremely high, applied design still greatly influences software's performance and reliability. Contemporary CPU are multithreaded by nature and many algorithms that work on large data sets need to utilize more than one processor that may also be separated by distance. Hence the need to introduce students to parallel computing architectures, parallel and distributed architectures.

Learning Outcomes

On completion of this unit the student will be able to:

1. *Apply the Unified Modelling Language in design and analysis of software systems;*
2. *Employ software testing strategies and assume the roles and responsibilities involved in the proper application of the process;*
3. *Understand parallel processing and multithreading techniques;*
4. *Understand concepts related to Artificial Intelligence.*

Unit: ETELX-606-1812 - Analogue Electronics 3

Unit level (MQF): 6

Credits: 6

Unit Description

This unit builds upon the fundamental principles covered in Analog Electronics 2 to present more applications based on op-amps and feedback. A wide variety of oscillators are covered from classic Wien bridge sine wave oscillators, square wave generators and other types of waveform generators. Techniques on how to control the signal amplitude and frequency are discussed as well as evaluating the quality of the generated waveform. Analog filters are an important tool in analogue design, apart from filtering unwanted signals they are necessary in mixed signal circuits to enforce the Nyquist criteria. Standard second order responses are described as well as different types of filter implementations. Design criteria using tables and software is also covered. As bandwidths increase the stability of op-amp based amplifiers become more critical. Non-linear circuits are an important class of circuits used for analogue signal processing. A learning outcome in devoted to discussing the various issues arising from the application of feedback on the stability of op-amps and method using to improve the phase margin.

This unit put an emphasis on the skills needed to design analogue circuitry using standard configurations. Students are encouraged to use software to synthesize and prototype different circuit configurations.

Learning Outcomes

On completion of this unit the student will be able to:

1. *Evaluate the operation of oscillators;*
2. *Investigate filter topologies and design a filter to fulfil a set of specifications;*
3. *Investigate and design non-linear circuits;*
4. *Assess the stability of linear circuits and compensate accordingly.*

Unit: ETELX-606-1529 - Control System Theory

Unit level (MQF): 6

Credits: 6

Unit Description

Control theory is an interdisciplinary branch of engineering that deals with the behavior of dynamical systems. Unlike many others it might integrate all areas of electrical engineering with mechanical or civil engineering for the purpose of designing complex systems. Even though the system is not very often recognized as the control system (CS), any modern system embeds the control subsystem to keep it running according to desired performances. In many cases in industry or in consumer electronics, an approach to design control system without a notion of the world around it would suffice. Furthermore, it is well supported by modern control technology and integrated in various components. To gain full impact, the control system must be designed as a complex, multi-disciplinary, hierarchically organized system, sometimes even with ability to interact with process in an intelligent way.

This course covers the basics needed to design stand-alone applications. It provides a critical review of Control Systems Theory by revisiting already acquired knowledge. It also delves into other fields, particularly those of state space system representation, analysis and design heavily supported by MATLAB and SIMULINK examples. This which will help the students' transition to tackling realistic control problems met in modern industry environment (mechanical systems, transmission, DC and AC motors, power electronics, filters, etc.).

Learning Outcomes

On completion of this unit the student will be able to:

1. *Obtain mathematical models in both s-domain and state space forms of electromechanical systems and use MATLAB to obtain responses of SS models;*
2. *Provide a linear state space model from a non-linear one and test for controllability and observability;*
3. *Design full state feedback using an observer;*
4. *Understand how to design simple compensators, controllers using root locus. diagrams, and be able to use automated tuning in MATLAB using root locus.*

Unit: ETELX-606-1813 - Programmable Logic Controllers

Unit level (MQF): 6

Credits: 6

Unit Description

Programmable logic controllers are being used worldwide in today's process and manufacturing industries. The course will focus on the practical perspective of the design, operational characteristics, internal architecture, construction and testing of PLC systems. Learners will be given the opportunity to perform practical work with various PLC brands widely used in the manufacturing and process industries. The software could be different programming methods as per IEC 61131-3 and interface the necessary hardware for a PLC system. The unit starts by describing the internal architecture of a typical PLC system using an available PLC as a demonstration. The operational characteristics of the CPU in executing a PLC program such as the scanning-cycle; design characteristics (types); Communication media types (cable types); a range of input and output devices; forms of signals such as digital and analogue, voltage and current; basic signal conditioning circuits; digital resolution and relationships; comparison of communication standards; PID control; Human-Machine Interface, networking methods and standards. Through the practical approach of the design of PLC control systems the unit exposes the learner to different PLC programming methods for typical manufacturing plant that may contain discrete, continuous, and batch processes.

Learning Outcomes

On completion of this unit the student will be able to:

1. *Evaluate a PLC architecture and develop ladder logic programs for various sequential applications;*
2. *Classify and compare types of sensors, actuators and their applications;*
3. *Evaluate typical standard and proprietary factory networks so to implement PLC-to-PLC communication;*
4. *Implement PID and HMI control in a PLC system.*

Unit: ETELX-606-1530 - Digital Signal Processing

Unit level (MQF): 6

Credits: 6

Unit Description

Digital Signal Processing (DSP) is an area of science and engineering that has developed rapidly over the past 30 years as a result of the significant advances in digital computer technology and integrated-circuit fabrication. Inexpensive and relatively fast digital circuits have made it possible to construct highly sophisticated digital systems capable of performing complex digital signal processing functions and tasks, which are usually too difficult and too expensive to be performed by analogue circuitry or analogue signal processing systems.

Digital processing hardware also allows programmable operations, while the signal processing functions to be performed by the hardware may be easily modified by means of the corresponding software. This enables a higher order of precision to be achieved through digital hardware and software as compared with analogue circuits and analogue signal processing systems.

This module presents an introduction to the basic analysis tools and techniques for digital processing of signals. It will particularly emphasise signal analysis using Fourier transforms, linear system analysis, and filter design exposing the student to real world signal processing problems.

Learners reading this unit should have passed the Signals and Systems unit. It is essential that coordination and collaboration takes place between and across modules so as to optimize the course to its full holistic value and maximise the learning potential of the learners.

Learning Outcomes

On completion of this unit the student will be able to:

1. *Understand discrete-time signals and systems;*
2. *Analyse systems using the DTFT and DFT transforms;*
3. *Evaluate discrete-time LTI systems by applying the z-transform;*
4. *Design an appropriate digital filter using system specifications and MATLAB.*

Unit: ETELX-606-1814 - Microcontrollers 3

Unit level (MQF): 6

Credits: 6

Unit Description

Embedded systems are an inescapable part of our daily lives. They are found in our domestic appliances; in our cars; in complex medical equipment; in specialized industrial machinery, and even in something as simple as a wrist watch. Our increasing dependence upon these special purpose systems brings with it a demand for greater sophistication, and connecting with them using various communication protocols including internet is vital across various microcontroller applications including Internet of Things (IOT). The aim of this module is to solidify and build upon a student's previously acquired knowledge of microcontroller systems. The concepts presented in lectures are accompanied with guided hand-on practical sessions so to give learners the opportunity to develop embedded distributed control systems using real time operating system services. Attention will also be given to the adoption of appropriate reliability and safety features for critical applications of embedded systems. This module assumes that the learner is already familiar with computer and network concepts, as well as with the use of some Internet applications. Further it is assumed that students are already familiar with embedded C programming.

Learning Outcomes

On completion of this unit the student will be able to:

1. *Develop distributed embedded control system software and hardware interfaces for various communication protocols;*
2. *Use Real Time Operating System services for a given specification;*
3. *Explain the importance of a dependability plan for an embedded system application.*

Unit: ETRBS-606-1801 - Robotics

Unit level (MQF): 6

Credits: 6

Unit Description

Robotics is the know-how and skill of designing, applying and using robots in human endeavours. Robotics increases productivity, safety, efficiency, quality, consistency and interchangeability of products. Robots are very powerful elements of industry today because they can perform various tasks and operations, are accurate, and don not need common safety and comfort elements human need. In any application robots can be useful but need to be designed, programmed and controlled. Robotics is an interdisciplinary subject and benefits from mechanical, electrical and electronics engineering, computer science, and many other disciplines.

The unit presents learners with introductory material, followed by robot design, and analysis of robot mechanics including kinematics, dynamics, differential motions. Learners will have the opportunity to use various industrial software tools to develop robotic simulation models, analysis mechanisms to transmit forces to manipulate objects and program robot manipulators. The course is delivered through practical hands-on exercises where students are guided to develop their skills required to design and program robotic hardware. As a prerequisite it is assumed that learners have an undergraduate-level knowledge of linear algebra, dynamics, and block diagram notation and achieved mathematics 1 unit.

Learning Outcomes

On completion of this unit the student will be able to:

1. *Evaluate the inverse and forward kinematics of robots;*
2. *Examine concepts of robot dynamics and differential motions;*
3. *Devise mathematical models to solve classical concepts of robot control and vision systems;*
4. *Build a robot program to operate and configure a robot-supported automation system.*

Unit: ETELE-606-1816 - Electrical Machines

Unit level (MQF): 6

Credits: 6

Unit Description

This unit presents the most widely used electrical machines in industrial applications. The unit revises the basic physical aspects of electricity and mechanics required for the understanding of electromechanical machines. The construction, mathematical modelling and operation under varying load conditions are studied for the DC, Induction and Synchronous Machines. The transformer is also studied due to its fundamental operation being similar to the induction machine. The control and drive applications of the electrical machines in this module are studied further in the unit Power Engineering: Motor Drive Applications.

This unit requires as a prerequisite Electrical and Electronic Principles, Physics for Engineers and Further Electrical Principles.

Learning Outcomes

On completion of this unit the student will be able to:

1. *Understand the fundamentals physics of electrical machines;*
2. *Evaluate the operation of DC Machines;*
3. *Evaluate the operation of Transformers;*
4. *Evaluate the operation of Synchronous Machines;*
5. *Evaluate the operation of Induction Machines;*
6. *Investigate the operation of motors used in control systems.*

Unit: ETCRL-606-1501 - Practical Control Engineering

Unit level (MQF): 6

Credits: 6

Unit Description

Process control concerns the design and specification of systems for the automatic control of process plant and equipment. It involves the measurement and manipulation of process variables such as flow, level, weight, temperature and composition. The objective is to drive measurements towards, and then maintain them at, a set of desired operating conditions. Modern process control is largely implemented by means of digital control systems and involves the application of a variety of techniques. In fact, advanced process automation and control covers a diverse range of modern, artificial intelligence, techniques and technology including expert systems, fuzzy logic, neural nets and genetic algorithms. So that the principles of measurement functions and regulation equipment, their mutual links and communication means, the tuning of the regulation loops with the different types of regulation and tuning procedures, play an essential role in contemporary control systems. Conducting processes through digital computers greatly simplifies and enhances the achievement of a set of desired operating conditions.

Practical control engineering deals with practical solutions of a variety of control problems. In this module, the basic principles governing the functioning of the control system components such as sensors and actuators will be introduced followed by the different control algorithms, their usage and tuning methods as well as the use of digital computer and system identification such that tuning is done offline. Conventional control strategies will also be addressed including the 3-term PID controller as the basis of feedback control. It accounts for something like 90% of all continuous control as used in the process industries, so a thorough treatment of the use and application of the 3-term control is necessary. PID control provides the basis for a variety of other strategies, e.g. cascade and ratio control, and is often used as the basis for feed-forward control.

Learning Outcomes

On completion of this unit the student will be able to:

1. *Design Fuzzy controllers using Matlab's fuzzy toolbox, implement as Matlab scripts and also on a microcontroller;*
2. *Obtain the input-output relationship of non-linear sensors/actuators, model them and linearize their static response by inversion;*
3. *Obtain a good enough model of a physical system, using both black box and parameter estimation techniques;*
4. *Design a PID on a system model and implement this PID in a microcontroller to control the behaviour of the physical system.*

Unit: ETMTH-606-1806 - Engineering Mathematics 5

Unit level (MQF): 6

Credits: 6

Unit Description

This unit prepares the learners to develop high level knowledge and skills that are required to solve complex engineering problems in order to deal with new technologies and challenges. Besides the basic mathematical topics of linear algebra and vector calculus, engineering students need good problem solving skills using numerical methods and approximate calculus.

Not all engineering situations can be solved analytically, hence the use of numerical methods. Such is the computational power today that even problems that have analytically solutions are now solved using numerical methods, computer simulations and software. The learners will hence be familiar with some software packages that help solve problems numerically. Also explored are iterative methods to solve nonlinear equations and systems, interpolation and approximation of functions, numerical derivation and integration, together with numerical methods for systems of differential equations, which are important classes of numerical methods. Learners should be proficient in such areas after completion of this unit.

This unit aims to introduce these concepts to the learners and prepare them to use them in engineering praxis. It is the fifth of a series of five Engineering Mathematics Units.

Learning Outcomes

On completion of this unit the student will be able to:

1. *Use iterative processes to solve systems of nonlinear equations;*
2. *Implement interpolation and approximation of functions;*
3. *Use and resolve problems involving quadrature rules to obtain numerical derivatives and integrals;*
4. *Apply numerical methods to systems of differential equations;*
5. *Use software packages to implement numerical methods and approximations.*

Unit: ETELE-606-1813 - Advanced Power Converters

Unit level (MQF): 6

Credits: 6

Unit Description

This unit presents further power electronic circuits to those presented in previous units. Single phase and three phase inverter circuits are reviewed with detailed analysis of switching schemes and harmonic content. Various types of resonant converters are also studied. Further DC-DC converters and direct AC-AC matrix converters are also studied. The unit is also aimed at the development of practical power electronic solutions including both firmware and hardware.

This unit has a prerequisite of Power Engineering: Basic Devices and Circuits.

Learning Outcomes

On completion of this unit the student will be able to:

1. *Evaluate the performance of single-phase and three-phase inverter circuits;*
2. *Investigate the operation of Resonant Converters;*
3. *Investigate the operation of Advanced DC-DC Converters;*
4. *Evaluate the performance of Matrix Converters;*
5. *Design and Test Advanced Power Converter Circuits.*

Unit: ETELX-606-1815 - Analogue Electronics 4

Unit level (MQF): 6

Credits: 6

Unit Description

The student is introduced to advanced techniques which are used in precision design. These types of techniques are required for high performance analogue circuits. This unit also covers the characteristics of noise and analyses methods of how to recover signals that are buried in noise. An overview of the effects of noise and interference are mitigated is discussed. Many systems operate in the digital domain hence the process of analogue to digital conversion and vice versa are described with the relevant effects on the analogue signal. Students are introduced to high level design of analogue systems using Field Programmable Analog Arrays (FPAA). The main objective of this unit is to apply theory with the aid of case studies and projects. A number of experiments are performed to demonstrate these concepts.

Learning Outcomes

On completion of this unit the student will be able to:

1. *Apply techniques to analyse and minimize Noise and Interference;*
2. *Design Analog and Mixed signal circuit systems;*
3. *Analyse and minimize the effects of errors on the operation of circuits;*
4. *Implement analogue circuit functions using Field Programmable Analog Arrays (FPAA).*

Unit: ETCRL-606-1502 - Advanced Digital Control Principles

Unit level (MQF): 6

Credits: 6

Unit Description

Control systems are nowadays an inevitable part of our everyday lives. They surround us everywhere. They are present in our houses, our appliances, our cars and hospitals. They monitor industrial processes, transportation and traffic. They support us underwater, in the air and even in space. The prevailing type of controllers in all these applications is digital controllers. There are several reasons why digital controllers have replaced analog controllers in the past few decades: ease of implementation of various linear and nonlinear control laws, flexibility, reliability, accuracy and low costs. Digital controllers, whose inputs and outputs are defined at discrete - time (DT) instances, are realized by digital circuits, digital computers or microprocessors.

At first, direct implementation of analog controllers by digital hardware has revealed that in certain cases performance deterioration or even instability can occur. This phenomenon has urged that all the analysis and methods developed for continuous-time (CT) systems should be revisited in discrete-time domain. This is exactly the core of the course Advance Digital Control.

This course covers the main topics in analysis and design of discrete-time systems, with special emphasis on modern techniques, such as state-space representation and analysis, frequency domain response etc. For better understanding of the matter, all course topics are supported by illustrated examples, elaborated in Matlab.

After brief review of basic concepts in continuous-time systems, this course starts with the general structure of digital control systems. Time discretization of signals is discussed, including their representation and properties in time and frequency domain. The necessary transforms are introduced. Signal reconstruction is presented, along with sampling theorem, zero-order and first-order hold. These set the background for further investigation of discrete-time systems.

The course proceeds with discrete transfer function of an open- and closed-loop digital control system, and evaluates system time responses upon common test signals. Steady state error analysis is then elaborated, as well as several types of realizations of digital filters and conventional digital controllers.

Next, state-space concept is expanded into discrete-time equivalent. Solution for state trajectory of a linear discrete-time system is obtained, and conditions for its controllability and observability are derived. Various forms of discrete-time state space models are presented. As equally important task from the aspect of state feedback design, state variable observation is reviewed, with particular reference to the Kalman filter as an observer.

A significant part of the course is devoted to stability of linear discrete-time systems. Correlation between time response and root locations in the z-plane is established. Several stability criterions are discussed: Jury's test, bilinear transformation and Routh-Hurwitz criterion, root-locus and Lyapunov stability analysis. The frequency response and properties of discrete-time systems are next presented with the associated Nyquist and Bode stability criterion.

Since continuous time design is well established, an interesting start would be indirect digital design. This approach is based on designing an analog controller for the continuous-time plant and then finding a discrete equivalent controller via numerical integration methods. Hence, design by emulation is also the topic of this course. Simple rectangular and trapezoid rules in numeric integration are presented. As case study, these approximations are applied in obtaining difference equations of conventional controllers and compensators.

Finally, all the theoretical concepts presented through the course will be linked with numerous illustrative examples, which will be supplemented, if possibly, by Matlab commands and procedures.

Learning Outcomes

On completion of this unit the student will be able to:

1. *Derive an adequate discrete time model in either transfer function or state space form;*
2. *Investigate system properties and perform stability tests;*
3. *Obtain discrete equivalents from continuous time models and design controllers in state space form.*

Unit: ETMGT-606-1507 - Strategic Management

Unit level (MQF): 6

Credits: 6

Unit Description

The aim of this module is to develop learners' abilities to think strategically. The unit will support the learner in analysing the business environment of an organisation. The tools that will be learnt throughout the module will help the learner to analyse the impact of the business environment on an organisation.

The unit will enable learners to gain an understanding of the different types of strategies that are available for management in order to pursue so that corporate objectives will be reached. The learner will be able not only to distinguish between the various strategies but also to make the most appropriate strategic choice that will bring an organisation in line to its business environment.

The learner will learn procedures that enable the smooth implementation of s chosen strategy within an organisation. Emphasis will be put on the role of culture and leadership. Reference will be made on the corporate social responsibility of an organisation and the importance of business ethics to ensure an effective strategic performance of a business.

The learner will be provided with opportunities to analyse organisations and their business environment. They will be provided with hands on experience in producing and analysing a strategic plan.

Learning Outcomes

On completion of this unit the student will be able to:

1. *Understand the basic principles of strategic management and its importance in a business environment;*
2. *Understand the business environment and its effects on strategy formulation;*
3. *Analyse the different types of strategies and their implementation;*
4. *Understand the role of corporate culture and leadership in strategy execution.*

Unit: ETELX-606-1816 - Microcontrollers 4

Unit level (MQF): 6

Credits: 6

Unit Description

Digital Signal Processing refers to the computation of intensive mathematical algorithms applied to data signals, such as audio and video compression, data coding/encoding, measurement, industrial control and digital communications. The first choice that comes to mind when looking for a processor to execute Digital Signal Processing applications on is the Digital Signal Processor (DSP). However, DSPs are crippled savants that excel at certain focused operations but struggling with the day-to-day tasks. Digital filtering and frequency analysis with Fourier transform requires many numbers to be multiplied and added together, so a DSP chip provides specific hardware and associated instructions to make these operations rapid and easier to code. It is possible to perform DSP applications with a microcontroller which have a long history in focusing in minimizing power consumption, interfacing to peripherals, and handling user interfaces. The recent boom in connected devices requires a need of products with both microcontroller and DSP features yielding to lower power consumption, ease of integration, and lower overall system cost. This unit describes the DSP, low-power features of a specific microcontroller and explains how to develop efficient code using DSP extensions that include specific instructions that accelerate numerical algorithms using mixed assembly and C language projects. Addition this unit explains strategies for optimizing DSP code on a microcontroller system. As a continuation from previous microcontroller units this module explains how to deal with deadlocks, nested interrupts, mutual exclusion, and sharing of data in an RTOS environment. Further unit content discusses redundancy strategies to satisfy reliability and performance requirements in an embedded system application.

Learning Outcomes

On completion of this unit the student will be able to:

1. *Produce digital signal processing applications on a microcontroller based system;*
2. *Evaluate DSP and microcontroller architectures for an embedded system application;*
3. *Produce mixed programming language projects for the realisation of an embedded DSP application;*
4. *Implement redundancy strategies for a fault tolerant embedded system.*

Unit: ETELX-606-1817 - Motor Drive Applications

Unit level (MQF): 6

Credits: 6

Unit Description

This unit elaborates further into the control of electrical machines studied in Power Engineering: Electrical Machines. The concept and application of electrical drives is studied with evaluation of DC Motor Drives, Induction Machine Drives and Synchronous Machine Drives. The investigation of sensor-less estimation and control applied to a variety of electrical machines is also carried out. A practical design project to assess the performance of a given electric drive is also to be carried out.

The prerequisites to this unit are Electrical Machines and Advanced Power Converters.

Learning Outcomes

On completion of this unit the student will be able to:

1. *Understand the Basics of Motor Drives;*
2. *Evaluate the performance of DC Motor Drive;*
3. *Evaluate the performance of Induction Motor Drive;*
4. *Evaluate the performance of Synchronous Motor Drives;*
5. *Investigate the Principles of Sensor-less Control.*

Unit: ETQLS-606-1501 - Quality Assurance

Unit level (MQF): 6

Credits: 6

Unit Description

Strategic quality requires that quality is defined as more than simply the absence of defects or the reduction of variation. This system of knowledge and applied technologies include, but is not limited to, development and operation of quality control systems, application and analysis of testing and inspection procedures. It also includes the ability to use metrology and statistical methods to diagnose and correct improper quality control practices, as well as an understanding of human factors and motivation, facility with quality cost concepts and techniques, and the knowledge and ability to develop and administer management information systems and finally to audit quality systems for deficiency identification and correction. In other words, quality is a comparison between one's product and those offered by others, a comparison made by people outside of one's firm. Without a set of principles, achieving a common understanding, the field of quality management would be impossible.

In supply products or services there are three fundamental parameters that determine their saleability – price, quality and delivery. The quality management system is the means by which the organization achieves its objectives and therefore no function or activity should be existing outside the system. Therefore, this unit will provide learners with the fundamental knowledge and the basic concepts in the field of quality. This unit covers fundamental principles of contemporary quality control, the quality improvement programs, introduces concept of ISO systems, and provides a broad spectrum of Measurement System Analysis.

Learning Outcomes

On completion of this unit the student will be able to:

1. *Apply fundamental principles of contemporary quality control methods to own products and organisations;*
2. *Apply Six sigma quality and Kaizen to improve own supply and services;*
3. *Apply an ISO system to own organisation;*
4. *Perform measurement system analysis for continuous data;*
5. *Apply statistical methods to quality control;*
6. *Use the correct and latest software tools to measure and implement quality management.*