MQF Level 4

Advanced Diploma in Industrial Electronics

EE4-A1-21

Course Description

The course is intended for candidates who wish to embark on a career as technicians in the field of electronics engineering which is one of the cutting edge fields at the forefront of the world´s technological advancements.

This area is currently in very high demand by industry and job opportunities in this sector are available in ever growing numbers.

This course is designed to give a good grounding in electronics where the student is exposed to the different aspects through class-based delivery and extensive hands-on practical workshops and projects.

Students are introduced to the creation of electronic systems in diverse fields, such as industrial electronics, transportation, computer engineering, communications and biomedical engineering.

In the first and second year of the course one will cover the core aspects of electronics engineering while in the final year, students will be required to select elective modules from Computer technology, Biomedical Technology, Telecommunications Technology, Control Technology, Electrical Power Technology, Domestic Installations and

Electronic Circuit Manufacturing. Availability of particular electives will be subject to a minimum number of applications.

Students will also have the opportunity to develop, design and build a cutting edge practical electronics project during the final year.

Programme Learning Outcomes

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

1. Work safely, communicate effectively in a team and take responsibility of own work in engineering.

2. Understand technologies currently in use in the wider electronics sector.

3. Work on installation and maintenance of electronics equipment and systems.

4. Develop and debug cutting edge electronic systems, and programing code.

Entry Requirements

MCAST Diploma in Engineering (Electronics)
or
MCAST Diploma in Electrical Installations
or
MCAST Diploma in ICT
or
MCAST Diploma in Heating, Ventilation and Air Conditioning
or
MCAST Diploma in Building Services Installations (Plumbing or Plumbing and Electrical)
or
MCAST Diploma in Welding and Fabrication
or
MCAST Diploma in Automotive Repair (Body and Paint)
or
MCAST Diploma in Light Vehicle Serving
or
MCAST Diploma in Mechanical Engineering
or
MCAST Diploma in Aircraft Maintenance
or
4 SEC/O-Level/SSC&P (Level 3) passes
or
4 SEC/O-Level/SSC&P (Level 3) passes
Compulsory: One subject from Mathematics or Physics and one subject from Engineering Technology, Design & Technology, Chemistry, Mathematics, Physics.

A medical certificate testing Colour Blindness is recommended for this course.

Current Approved Programme Structure

Unit Code	Unit Title	ECVET
ETENG-406-1801	Engineering Science	6
ETELX-406-1801	Analogue Electronics 1	6
ETELX-406-1507	Microprocessor and Microcontroller Technology	6
ETELX-406-1511	Power Electronics	6
ETELX-406-1510	Electronic Circuit Manufacture	6
ETELX-406-1515	Automation and Control	6
ETELX-406-1504	Digital Electronics	6
ETSFT-406-1509	Programming Concepts	6
ETELE-406-1803	Electrical technology	6
ETMTH-406-1617	Mathematics for Engineering	6
ETELE-406-1804	Authorisation A Part 1	6
ETELX-403-1802	Analogue Electronics 2	3
ETNET-406-1801	Computers and Networking	6
ETH&S-403-1801	Health and Safety	3
*	Elective 1*	6
*	Elective 2*	6
ETPRJ-406-1801	Engineering Project	6
CDKSK-406-1602	Mathematics	6
CDKSK-406-1604	English	6
CDKSK-406-1603	Entrepreneurship	6
ETCMP-406-1801	Vocational Competences in Industrial Electronics	6
	Total ECVET	**120**

*Refer to list of electives table and elective groupings below

List of Electives

Unit Code	Unit Title	ECVET
ETELX-406-1508	Field Programmable Gate Arrays	6
ETSFT-406-1510	Programming Languages	6
ETELX-406-1503	Microcontrollers	6
ETTLC-406-1502	Telecommunications Principles	6
ETTLC-406-1503	Communication Technologies	6
ETMDL-406-1503	Medical Imaging	6
ETMDL-406-1502	Medical Therapeutics	6
ETWEB-406-1502	Internet Technologies and Web Design	6
ETNET-406-1508	Routing Basics	6
ETELX-406-1516	Applications of Power Electronics in Electrical Motor Drive Systems	6
ETELE-406-1805	Authorisation A Part 2	6
ETELX-406-1803	Advanced PCB design	6
ETELX-406-1824	Advanced PCB manufacturing	6
ETMTH-406-1801	Maths for Engineering Degree	6

Elective Groupings

Stream	Electives to choose in 3rd year
Computer Technology	• ETWEB-406-1502- Internet technologies and Web Design • ETNET-406-1508 Routing Basics (CCNA2)
Biomedical Technology	• ETMDL-406-1503-Medical Imaging • ETMDL-406-1502-Medical Therapeutics
Telecommunications Technology	• ETTLC-406-1502-Telecommunications Principles • ETTLC-406-1503-Communication Technologies
Control Technology	• ETELX-406-1508-FPGAs • ETELX-406-1503-Microcontrollers
Electrical Power Technology	• ETLEX-406-1516-Application of Power Electronics in Electrical Motor Drive Systems • ETELE-406-1805-Authorisation A Part 2
Degree Preparation	• ETSFT-406-1510-Programming Languages • ETMTH-406-1801-Maths for Engineering Degree
Electronic Manufacturing	• ETELX-406-1803-Advanced PCB Design • ETELX-406-1824-Advanced PCB Manufacturing

Unit: ETENG-406-1801 - Engineering Science

Unit level (MQF): 4

Credits: 6

Unit Description

This unit will expose the student to the basic principles of Science necessary to support other engineering units. It will specifically delve into the underlying physics and chemical concepts which would be essential to understand the engineering knowledge concepts.

This unit will start by outlining the principles of physics underlying the basic electrical AC and DC concepts. It will then go on to explain the fundamental differences between Insulators and Conductors as well as outline the basic circuit theorems.
Another area of relevance to this unit would be the electrostatics and electromagnetic induction on which the student would then be able to build further technical knowledge.

The final part of the unit is aimed to give the student a solid understanding of materials including their chemical properties. This would allow the students to have sufficient knowledge required when selecting the proper material to use for particular applications.

As all the other units in this course this unit is expected to include a strong practical component.

Learning Outcomes

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

1. *Understand the basic physical principles of electricity and the basic concepts of AC and DC.*
2. *Understand the physical differences between insulators and conductors.*
3. *Perform basic calculations by applying Ohm's Law and other circuit theorems.*
4. *Understand and apply the basic principles of electrostatics and electromagnetic induction.*
5. *Describe different materials and their chemical properties.*

Unit: ETELX-406-1801 - Analogue Electronics 1

Unit level (MQF): 4

Credits: 6

Unit Description

Electronics and electronic devices are used in a wide range of manufactured products. From everyday popular items such as mobile telephones and cameras to the robotics used in industry, jet aeroplanes and medical equipment, the use of electronics is continually growing.

The two major uses of electronic devices are in handling signals by amplifying and switching, resulting in applications in information processing, signal processing, and communications. Mixed on a circuit board, electronic devices become part of many household and industrial systems and in contemporary days they are even becoming integral, embedded part of mechatronic systems.

This unit aims to give learners a practical introduction to basic discrete electronic devices and analogue principles. This will build learners' confidence in their ability to simulate and test a variety of electronic circuits.

It will provide knowledge on how diodes and transistors operate as the two most important elements in an electronic circuit. Learners will also be exposed to the application of analogue circuits, their structure, their operation and the way in which they are differentiated from each other.

Besides building and testing electronic circuits on a breadboard and veroboard, learners will also be exposed to computer-based circuit design and simulation software packages that will allow them to understand the first steps of building and testing electronic circuits.

Learning Outcomes

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

1. *Understand the function and operation of basic electronic components.*
2. *Apply the concepts of basic electronic devices to understand the operation of basic analogue electronic circuits.*
3. *Investigate, describe and demonstrate the operation and applications of identified discrete transistor amplifier circuits.*
4. *Simulate, construct and test simple analogue electronic circuits.*

Unit: ETELX-406-1507 – Microprocessor and Microcontroller Technology

Unit level (MQF): 4

Credits: 6

Unit Description

Microprocessors emerged around the mid 1970‘s. Their word size has grown from 4 bits to a gigantic 64 bits. Similarly, their speeds have dramatically increases from around 1MHz to a few GHz. These complex CPUs (microprocessors) were more suited to general computing systems, hence the development of the personal computer world. The microprocessor had limited impact on Engineering Applications and Systems.
A few years after the invention of the microprocessor, the microcontroller was conceived. This ‘computer on a chip’, completely revolutionised the design of Electronic Systems and Engineering Applications. Designs based on the microcontroller are referred as embedded systems.

Microcontrollers are used in most everyday equipment such as washing machines, microwaves, TVs, cars, digital cameras and lots of other items and applications.

In this unit the candidate will learn the basic architecture of both the microprocessor and the microcontroller, associated memory devices and demonstrate the operation of the devices.

The unit comprises of three parts. First the candidate will learn the generalised block diagram of small microprocessor system and discuss the function of the individual subsections within the block diagram. This discussion will be used to develop the internal architecture of the microprocessor. The candidates will then learn that the internal architecture of the microcontroller is similar to that of the microprocessor but has peripheral devices included, such as ADC, ports and timers etc.

The candidate will then learn about the many different memory devices that can be used with microprocessor systems and which ones are found inside a microcontroller. Memory devices covered include RAM, ROM, EPROM, and EEPROM.

Finally, the candidate will focus on a particular memory device. Learn to program the selected memory chip using software and device programmer. The programmed device will be interfaced to a microcontroller and a functionality test will be performed.

Learning Outcomes

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

1. *Analyse Microprocessor and Microcontroller architectures and operations.*
2. *Outline the structure and use of a microcontroller-based system.*
3. *Program, run, interface and test a microcontroller-based system.*

Unit: ETELX-406-1511 – Power Electronics

Unit level (MQF): 4

Credits: 6

Unit Description

This unit aims to give learners an understanding of basic principles of Power Electronic devices and circuits. It is delivered with a high practical content which will build learners' confidence in their ability to simulate and test a variety of power electronic circuits.

The learners are first introduced to the different types of power electronic device which form the building blocks of power electronic circuits. They study the reason why these circuits are used, their structure, their operation, the way in which they are differentiated from each other, their applications and their electrical and thermal protection methods.

Once they have a firm grasp of power electronic devices the learners are introduced to the power electronic circuits that they are used in. They will examine in detail their configuration, operation and applications. Direct Current, Single phase alternating current and three phase alternating current circuits are examined.

The learners then move onto using the basic design calculations that will allow them to predict a circuits operation to meet a given specification.

The circuits are then operated and tested by the learners who will gather results to confirm their theoretical predictions.

Modern design tools involving electronic computer aided design, schematic capture and simulation will be employed by the students at all stages throughout the course.

Learning Outcomes

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

1. *Describe the purpose, structure, operation, transfer characteristics, applications and protection requirements of identified power semiconductor devices.*
2. *Explain the configuration, operation and application of simple power electronic convertor circuits.*
3. *Calculate the mean operational output voltage and output current of simple power electronic convertor circuits to meet a given specification.*

4. *Verify that the mean operational output voltage and output current of simple power electronic convertor circuits meets a given specification.*

Unit: ETELX-406-1510 – Electronic Circuit Manufacture

Unit level (MQF): 4

Credits: 6

Unit Description

This unit aims to give learners an understanding of basic principles of the design and manufacture of electronic circuits. It is delivered with a high practical content which will build learners' confidence in their ability to schematically capture, simulate, layout and construct an electronic circuit and its mounting.

The learners are first introduced to the different types of electronic device which form the building blocks of electronic circuits. They study the reason why these circuits are used, their structure, their operation, the way in which they are differentiated from each other and their application.

Once they have a firm grasp of the main electronic devices, the learners are introduced to the use of an Electronic CAD package to schematically capture and simulate an electronic design. They will examine in detail how the simulation tool can be used to refine the operation of the circuit so that when it is built its operation is "right first time". They will also be introduced to the conventions associated with the layout of electronic schematics and the communication of engineering procurement information via Bills of Materials.

The learners then move onto learning the principles behind the layout of a double sided Printed Circuit Board and the use of Electronic CAD packages to import schematic net lists and layout PCB designs.

The learners will then manufacture a through-hole printed circuit board, populate it and test it against their simulated results to certify its correct operation. They will use electronics soldering equipment and hand tools to construct and debug the circuit boards.

The learners will then make use of a suitable mechanical CAD package to design a suitable enclosure or mount for their working printed circuit board.

Learning Outcomes

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

1. *Identify and describe electronic components and test instruments regarding their purpose, structure, operation, circuit schematic symbols and application.*
2. *Use Electronic Computer Aided Design and Simulation software to perform electronic schematic capture, simulation and test of electronic circuits to meet a given specification.*
3. *Design a Printed Circuit Board to meet a given specification.*
4. *Assemble, construct and test a PCB based electronic circuit to meet a given specification.*
5. *Use a 2D CAD package to design a mechanical mounting or enclosure for an electronic PCB based circuit to meet a given specification.*

Unit: ETELX-406-1515 – Automation and Control

Unit level (MQF): 4

Credits: 6

Unit Description

This unit provides a framework for students to describe the terminology and function of programmable logic controllers and the use of instructions and their concepts and applications into the engineering environment.

The unit starts to focuse on the functions of logic gates and the use of truth tables and describes the basic elements involved with PLC systems, their internal architecture and design characteristics of programmable logic control systems, the signalling and the programming techniques that are used to devise programs for them to carry out small to medium scale control tasks.

This unit involves some underpinning theory, but focuses further into practical situations that will be examined using both computer simulation tools and also a PLC.

Learning Outcomes

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

1. *Understand the Design and Operational Characteristics of a PLC.*
2. *Understand PLC Information and Communication Techniques.*
3. *Apply and Test PLC Programming Methods & Techniques.*

Unit: ETELX-406-1504 – Digital Electronics

Unit level (MQF): 4

Credits: 6

Unit Description

The study of Digital Electronics is essential to an understanding of the underlying operation and design processes behind the electronics that is used by the candidate in daily life. Computers and their associated network routers, hubs and switches that make up the internet; tablets; mobile phones; portable music players; games consoles; satellite transmitters and receivers; televisions; digital radio and many other applications all use the devices and circuit design techniques studied in this unit.

The delivery of this unit splits into five parts. Firstly, the candidate will learn about the binary and hexadecimal number systems that are used by digital devices. The candidate will then learn about the representation and operation of the basic logic gates that act as the building blocks of digital electronic circuits.

The candidate will then learn how to design and implement combinational logic circuits. The full design process will be followed from initial specification to the building and testing of circuits to meet that specification. The application of truth tables, Boolean Algebra, Karnaugh maps, single logic implementation and timing diagrams in the design of combinational logic circuits is studied and practised. A structured approach to the testing and debugging of combinational logic circuits using digital logic probes and digital logic pulsars is also practised.

The unit will then move on to teach the candidate about the design and implementation of sequential logic circuits. The differences between combinational and sequential logic will be examined. The candidate will then move on to study the application of state transition diagrams; state tables; transition excitation tables and Karnaugh maps to the design and simplification of sequential logic circuits. A structured approach to the testing and debugging of sequential logic circuits using digital logic probes and digital logic pulsars is also practised.

The unit will then examine the use of prebuilt combinational and sequential logic circuits packaged in the form of Medium Scale Integrated Circuits.

Finally, the candidate will be introduced to the schematic capture, implementation and testing of combinational and sequential logic circuits in programmable logic devices.

Modern design tools involving electronic computer aided design, schematic capture and simulation will be employed by the students at all stages throughout the course.

Learning Outcomes

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

1. *Solve arithmetic and logic problems in digital circuits.*
2. *Design, build and test basic combinational logic circuits to meet a given specification.*
3. *Design, build and test basic sequential logic circuits to meet a given specification.*
4. *Identify, build and test basic Medium Scale Integration (MSI) digital circuits to meet a given specification.*
5. *Identify the basics of Programmable Logic Devices.*

Unit: ETSFT-406-1509 – Programming Concepts

Unit level (MQF): 4

Credits: 6

Unit Description

The 'C' Programming Language is a widely used and versatile general purpose computer programming language found in many engineering applications such as Embedded Computing. It has many derivatives within areas such as GUI development, gaming and control. This unit provides an introduction to the concepts of computer programming using the 'C' Programming Language as its basis. The unit is intended to guide learners through the basics of computer programming from the need for a programming 'language', the basic constructs used within the 'C' language and implementation of program flow with the unit culminating in the development of an application to solve an engineering problem.

Outcome 1 focuses on the fundamental structure of a computer from a programmers' view point (including ROM, RAM and Machine Code). With this underpinning knowledge it is then possible discuss the history of the 'C' language and to see the benefits that it brings to the user.

Outcome 2 concentrates on the 'C' language fundamentals such as syntax, statements and the design of code – flowcharts and commenting. Learners will be introduced to concept of data types, libraries, and overall code structure for simple linear programs.

Outcome 3 looks at the implementation of lists and arrays, conditional (decision) statements - such as 'if', 'for' and 'while' – as well as the use of pointers in the 'C' programming language. Learners will understand how to use conditional statements to repeat program step, how to access data from arrays and use pointers to perform memory management.

Outcome 4 introduces the concept of functions or sub-routines to simplify programming structure and development time as well as reducing overall code footprint. Learners will also be given the opportunity to demonstrate their mastery of the Unit by developing a 'C' language program implementing all of the features they have studied in order to solve a specified engineering problem.

Learning Outcomes

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

1. *Describe benefits of the 'C' Programming Language over Low-Level Languages.*
2. *Explain and use the basic programming constructs of 'C' (inc. Libraries).*

3. *Produce 'C' programs with the ability to change flow conditionally, search lists and manage memory.*
4. *Implement 'C' functions or sub-routines to simply programming structure.*

Unit: ETELE-406-1803 - Electrical Technology

Unit level (MQF): 4

Credits: 6

Unit Description

Electrical Technology is the basis of all Electrical and Electronic Engineering subjects. The principles that are outlined in the course are fundamental to a learner's knowledge for a successful career in this area. Although electrical based, the knowledge contained in this unit will be important across all engineering and technical disciplines. The topics covered allow the learner to consider what is happening when practical activities are taking place and to appreciate electrical power and its consequences.

This unit is the second in a series that looks at the building blocks of electrical technology. By undertaking this unit knowledge will be gained that is required to progress towards more advanced electrical and electronic subjects.

The knowledge gained from this unit can be carried through to many different courses and can be looked on as giving the learner a broad and flexible base for further Electrical and Electronic studies. This unit mainly involves principles of magnetic theory, DC transient theory and analysis of three phase systems. It covers the basic operation and construction of various types of electrical machines.

Learning Outcomes

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

1. *Apply DC transient theory to more complex problems in C-R and L-R DC circuits.*
2. *Explain and apply AC theory to single phase circuits and three phase systems.*
3. *Use principles of magnetic theory to investigate the electrical and operational performance of electrical machines.*
4. *Investigate the operation of different types of electrical machines.*

Unit: ETMTH-406-1617 - Mathematics for Engineering

Unit level (MQF): 4

Credits: 6

Unit Description

This unit has been designed to build upon previous theoretical mathematical knowledge, to be used in a more practical context. Furthermore, it acts as an essential basis for the successful completion of other units within the program of study. Delivery of the unit should be set within the engineering context.

The learner will be able to understand and apply algebraic techniques to manipulate expressions and solve algebraic equations commonly found in engineering. This includes linear simultaneous equations, logarithmic equations, exponential equations and series. Furthermore, the learner will also learn that algebraic equations can also have complex roots whenever an algebraic expression is found not to have real roots.

This unit was also designed to deal with geometric and trigonometric analysis to give an extra tool to the learner in how to deal with sides, angles, perimeters, areas and volumes. Furthermore, the learner will also know how to find the surface area of irregular shapes by applying numerical integration and by definite integration. All of this will be applied to engineering contexts.

Part of the syllabus will deal directly with graphical techniques in which the learners will further their studies by introducing higher order equations, trigonometric and logarithmic equations. They will also learn how to solve equations graphically and hence how to find the gradient at a point by using differential calculus.

On successful completion of the unit the learner will be equipped with sufficient mathematical skills to be able to deal with mathematical competencies found in the vocational units at level 4 and even further studies at higher levels.

Learning Outcomes

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

1. *Apply algebraic techniques to manipulate expressions and solve equations.*
2. *Apply techniques to manipulate complex numbers and series.*
3. *Apply trigonometric techniques to solve engineering problems.*
4. *Apply geometric techniques to solve engineering problems.*
5. *Apply graphical techniques to solve equations.*
6. *Apply calculus to solve practical problems.*

Unit: ETELE-406-1804 - Authorisation A part 1

Unit level (MQF): 4

Credits: 6

Unit Description

This unit leads the student to understand the basic concepts of simple single phase standard electrical circuits commonly used in domestic installations. Assessment of load maximum demand and use of diversity factors are important concepts in the design of electrical installation circuits. This unit gives the student the background knowledge to design reliable and safe electrical systems.

To do this the student learns to design systems which sustain the design load currents, prevent fire risks, and ensure that faults are cleared if the case requires. Standard methods of labelling are also thought and also circuit cable design with the inclusion of simple voltage drop calculations.

The unit will also detail how a single phase 40A consumer unit need to be set up with the relevant metering and protection switchgear in place. Standard colour coding will be used throughout all circuits and will also be introduced to the learner in the three phase scenario.

Learning Outcomes

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

1. *Carry out installations of single phase final circuits commonly used in domestic installations.*
2. *Install all the control / protection required for a single phase domestic installation and calculates the supply Maximum Demand with the use of Diversity.*
3. *Design a domestic electrical supply circuit from protection to load; taking discrimination, circuit cable design and voltage drop into consideration.*
4. *Understand earthing systems and their applications for single phase and three phase installations up to 300A.*

Unit: ETELX-403-1802 - Analogue Electronics 2

Unit level (MQF): 4

Credits: 3

Unit Description

This unit follows Analogue Electronics 1 which lays important and wide-ranging foundations and provides the opportunity for learners to simulate, implement and test various simple analogue electronic circuits. Analogue Electronics 2 builds on these foundations by further analysing and applying discrete components and considers the operation of integrated circuits such as operational amplifiers.

This unit will focus on the development of circuits that employ both discrete components and integrated circuits such as operational amplifiers. Learners will be able to apply their understanding in the building, testing and troubleshooting of analogue electronic circuits. This will also extend learners' competency in construction techniques and in the use of standard laboratory equipment.

Practical work will be complemented by the use of a computer-based simulation software package which will enable learners to evaluate and verify circuit operation prior to their construction.

Learning Outcomes

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

1. *Understand and apply fundamental analogue principles.*
2. *Describe and verify the operation and application of analogue electronic circuit systems and their components.*
3. *Analyse analogue electronic circuits using practical experiments.*

Unit: ETH&S-403-1801 - Health and Safety

Unit level (MQF): 4

Credits: 3

Unit Description

Integrated Workplace Health and Safety legislation can best be defined as the pre-requisite requirement necessary to maintain the well-being and protection of employers, employees and the environment.

Organisations are legally bound to adopt a proactive approach, educating employees on the importance of promoting safe working practices, in order to maintain a safe and healthy working environment.

Taking cognisance of the aforementioned, the aim of the unit is to introduce candidates to key elements relating to fundamental Health, Safety and Environmental legislation. This unit is intended to be delivered as an intensive 3 credit module to all Level 4 Electrical and Electronics students. This will give them the tools required to work safely in their chosen fields.

The unit seeks to highlight the fact that Health and Safety is an issue for everyone, no matter the level at which they are employed. It aims to inform individuals about their responsibilities in the working environment, in the context of say, what constitutes a safe working area and what's required to achieve this in differing scenarios.

The unit is intended to be delivered as practical unit with realistic visits to workshops on MCAST campus in view to conduct assignments such as risk assessments.

Coupled to this a sound grounding in how safety legislation is formulated and controlled, provides a very useful basis, from which the student's understanding of how these requirements are applied in the workplace.

Learning Outcomes

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

1. *Explain the key features of Local and EU Health and Safety legislation.*
2. *Explain and describe employers and employees' specific roles and responsibilities in relation to the act.*
3. *Identify, Evaluate and Control Risk within a Workplace Environment.*

Unit: - ETPRJ-406-1801 Engineering Project

Unit level (MQF): 4

Credits: 6

Unit Description

In this unit, learners will construct a project to address an engineering problem related to their engineering discipline. Learners will have the opportunity to use the knowledge and skills they have gained in other vocational units to carry out tasks that reflect the type of performance expected in an engineering/technical setting. This unit will provide an environment that helps learners develop the ability to identify, plan and follow procedures to produce a feasible solution to agreed specifications and within an agreed timeframe. Students will also be subject to the use of a logbook to record their work and decisions. Students will manage the development of their project as independently as possible. However, they will be encouraged to seek support and guidance when necessary. In this unit, students will have the opportunity to develop further practical skills related to their engineering discipline but also develop important soft skills such as problem solving, negotiation, self-awareness, budgeting, time management and decisiveness.

Learning Outcomes

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

1. *Specify a project, choose a solution and agree procedures to address an engineering problem.*
2. *Plan and record the work carried out on a project.*
3. *Implement the project plan safely and within agreed procedures, timeframes and quality standards.*
4. *Present the project outcome.*

Electives

Unit: ETELX-406-1508 - Field Programmable Gate Arrays

Unit level (MQF): 4

Credits: 6

Unit Description

This unit aims to give learners an understanding of basic principles of the design of customised integrated circuits using programmable logic gate arrays. It is delivered with a high practical content which will build learners' confidence in their ability to design, program, simulate and test a variety of logic designs using programmable logic devices and programmable logic design tools.

The learners are first introduced to the internal architecture of simple programmable logic devices (PLD's), the features available on simple programmable logic devices and the technologies used to create programmable links within the devices.

The concept of more complex programmable logic in the form of Field Programmable Gate Arrays (FPGA's) is then introduced. The learners are first introduced to the internal architecture of these devices (PLD's), their available features and the technologies used to create programmable links within the devices.

The learners are then introduced to a comparison of the advantages and disadvantages in the implementation of logic circuits using FPGA's as opposed to the use of simple programmable logic devices and function customised devices.

Finally, the learners will be introduced to the use of the computer design and programming tools used to create a logic circuit in a FPGA that will fulfil a given specification.

Learning Outcomes

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

1. *Explain the PLD architecture, features and programmable link hardware.*

2. *Explain the FPGA architecture, features and programmable link hardware.*
3. *Differentiate FPGA's from programmable and fixed function customised integrated circuits.*
4. *Use FPGA design tools to create a combined combinational and sequential logic circuit in a FPGA that will fulfil a given specification.*

Unit: ETSFT-406-1510 - Programming Languages

Unit level (MQF): 4

Credits: 6

Unit Description

C# is a programming language designed for building a wide range of enterprise applications that run on the .NET Framework. Visual C# .NET enables developers to build solutions for a large range of clients such as Microsoft Windows Forms-based applications, Web applications and thin- and smart-client devices.
This course is designed to enable learners to gain an understanding of the fundamental techniques used in the development of computer programs, beginning with the analysis of a problem through to designing, coding, and documentation, testing, debugging and evaluating a solution in the form of computer program that meets the requirements of a given specification.

This unit is mainly theory based and introduces learners to the software development lifecycle examining different developmental models and stages. Also, learners will have an opportunity to familiarize with different categories of programming languages such as object-oriented and scripting. Therefore, emphasis will be placed upon code translation and code levels.

Learners will cover C# programming language structure, syntax and statements. Learners will be introduced to data types, operands and operators. Learners will use a range of operators such as arithmetic, comparators, logic, Boolean and others. Learners will be made aware of operator precedence. Emphasis will be placed on understanding, naming and defining variables. The unit will focus on learners understanding and using arrays and collections. Furthermore, the unit will cover decisions making in code using relational and logical operators and switch statements. Equally, learners will gain an understanding of statement repetitions using loops and nested control structures. Students will gain an understanding of objects, properties and methods. Learners will learn how to read and write data in and from an external text file or database file. Importantly, students will be introduced to exception handling and debugging. Learners will also be creating and testing of computer programs to meet a given specification.

Learners will be encouraged to design a solution before coding. Using knowledge and skills acquired in the unit, learners will create programs to closely match any given specification and will learn to devise a simple testing strategy to ensure that programs produced, as far as possible, are robust, provide accurate results and meet the specification. Furthermore, learners will be encouraged to use any available debugging facilities as appropriate. Finally, emphasis will be placed in learners need to understand that code should conform to organisational standards, including the use of internal documentation and indentation.

Learning Outcomes

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

1. *Describe the process of software development.*
2. *Use the basic structure and features of a programming language.*
3. *Produce a computer program to meet a given specification.*

Unit: ETELX-406-1503 - Microcontrollers

Unit level (MQF): 4

Credits: 6

Unit Description

This unit aims to give learners an understanding of basic principles of Microcontroller based devices and circuits. It is delivered with a high practical content which will build learners' confidence in their ability to program and use a microcontroller for the purpose of controlling an electronic circuit or small scaled embedded applications.

In order to successfully program a microcontroller based system the learners must first have a clear understanding of its internal structure. Therefore, the unit first gives a brief history of computing, outlines the computer hardware organisation, describes overall organisation of a processor, details the characteristics of a microcontroller and embedded system and summarises the 8-bit, 16-bit, and 32-bit microcontroller market.

The learners are then given an overview of a specific microcontroller family where they examine the memory space, CPU registers, operation and organisation. Once the learners understand the overall structure and operation of the microcontroller then they will examine the various addressing modes and a subset of the assembly language instructions.

The learners are then introduced to the basic assembly language programming skills such as arithmetic operations, program loops, data shifting and time delay of a microcontroller through the development of assembly language programs. Through practical sessions the learner will then be able to familiarise with development tools and demonstration board so to understand how to use an integrated development environment to enter, assemble, and execute the program, using a simulator or demo board.

Once the learners familiarize with the development tools and microcontroller internal structure then through tutorials they are introduced to embedded C programming language, where they will learn how to develop C programs to manipulate the various microcontroller registers and bits. The unit then deals with the concepts of parallel I/O; I/O pin configurations; and demonstrates how to use parallel I/O PORTs to drive various peripherals such as LEDs, switches, seven segment displays, liquid crystal displays and stepper motor. The learner will be exposed in building and program the required hardware peripheral interfaces. Finally, the unit delineates the basic structure of a data acquisition system, and the A/D and D/A convertor modules. Through the development of programs and building of hardware interfaces the learners will then explore how to use the ADC to measure physical quantities, transfer data serially using

UART (e.g. voltage, temperature) so to monitor and control a small scale engineering system to a given specification.

Modern industry standard IDE based design and debugging tools will be employed by the students at all stages throughout the course.

Learning Outcomes

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

1. *Explain the purpose, architecture and operation of a microcontroller based embedded industrial system.*
2. *Develop and implement embedded assembly language programs to read internal data, process it and produce an internal result.*
3. *Develop and implement embedded C language programs to read external data, process it and produce an external result.*
4. *Develop and implement embedded hardware and software programs to fulfil a given small scale embedded industrial control situation.*

Unit: ETTLC-406-1502 - Telecommunications Principles

Unit level (MQF): 4

Credits: 6

Unit Description

This unit provides a framework for students to develop an understanding of the principles and characteristics of present day telecommunications systems.

This unit will focus on the properties of a telecommunications system and a basic understanding of the various networks used to transmit voice, video and data signals from one location to another.

The unit will also look at the communications system, which consists of an input device, transmitter, transmission medium receiver and output device as well as the basic structure of these elements and their characteristics.

The electromagnetic spectrum for telecommunications is also focused on as it indicates the frequencies at which various guided and unguided transmission techniques operate.

The use of practical/ defective signals on the channels and the presence of noise sources will be considered and the various methods of reducing their effects. It also identifies and describes the factors affecting Electromagnetic Compatibility (EMC) issues and how these can be minimised by good design practice.

The unit will also provide the candidate with an understanding of the modulation, demodulation and multiplexing techniques used in the telecommunications industry and applies these methods to explain the function of various RF circuits that are used in transmitters and receivers.

Guided data transmission media such as twisted pair, coaxial cable, optical fiber and unguided data transmission such as transmission lines, terrestrial microwave and satellite microwave are also analysed.

Learning Outcomes

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

1. *Understand the requirements of a telecommunications system, channels and their main components and characteristics.*
2. *Understand the Electromagnetic Spectrum and also the various effects of noise, explaining methods that can be applied to reduce the effects of noise.*
3. *Understand modulation, demodulation and multiplexing techniques.*

4. *Understand the various guided transmission and wireless (unguided) transmission mediums which are used in telecommunications systems.*

Unit: ETTLC-406-1503 - Communication Technologies

Unit level (MQF): 4

Credits: 6

Unit Description

Data Communication networks are developing rapidly and this unit will help the learner to appreciate, understand and use the communication networks and services that they provide that are now an everyday part of both our personal and business lives.

This Unit is designed to develop broad general knowledge and understanding of the theoretical concepts, principles, and mechanisms that allow us to use computer systems to communicate.

This includes knowledge of network topologies, network services, media and the way in which the computer systems access the transmission media, providing an introduction to how data can be represented electronically and introduces how multiple signals can be represented and carried on the same transmission media.

It also covers the equipment that most commonly is used to access the core network and completion of the unit will provide foundation knowledge of, and allow the student to describe the different transmission protocols and models of transmission, allowing them to compare and contrast the OSI seven-layer model with the TCP/IP model in particular.

The study of the Unit will be of particular benefit to those who wish to undertake further study in the fields of data communications, especially to those who wish to provide technical support to other users.

Learning Outcomes

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

1. *Understand the topologies and communication principles of different types of networks.*
2. *Understand and describe different transmission protocols and models of data transmission*
3. *Understand and describe the different communication methodologies*
4. *Understand and use different methods of Internet Communications and identify the different protocols employed.*

Unit: ETMDL-406-1503 - Medical Imaging

Unit level (MQF): 4

Credits: 6

Unit Description

Medical imaging is the method whereby we are able to look inside the human body. There are several medical imaging technologies, each used for different applications. Sometimes, different technologies are used in conjunction with each other. Medical imaging is a fundamental tool both in diagnosis and treatment of medical conditions. Examples of diagnosis in the musculoskeletal system include the ability the determine bone fracture, whereas in the neurological system, an MRI gives information on the presence and location of tumors and also on the function of the brain. During surgical intervention, the use of imaging guides the surgeon around the necessary organs and pipes to the real the point of interest.

Medical personnel are usually responsible for functioning the equipment, however it is the duty of the engineer to design, manufacture, maintain and calibrate the device according to the user's specifications and to ensure that the equipment operates well. Therefore, this is one area whereby the engineer must be able to understand the requirements from the medical professionals.

The aim of this unit is to introduce and give the student a basic but broad knowledge of the different medical imaging equipment commonly used in hospitals and clinics, their applications and their functionality compared to other imaging devices.

Operating such equipment requires training, and some more than other, pose certain health risks which must be kept to a minimum. The advantages and disadvantages of different medical imaging equipment will be discussed, based on the governing parameters, giving the student an oversight of the complexity involved in utilizing and maintaining such equipment.

Learning Outcomes

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

1. *Explain the functionality of each medical imaging system and the applications in which they are used.*
2. *Identify the strengths and weaknesses of the different imaging systems.*
3. *Explain the main parts of equipment used for each imaging system, and how the image is obtained.*
4. *Explain the health and safety implications of each system.*
5. *Identify the differences between digital and analogue imaging systems.*

Unit: ETMDL-406-1502 - Medical Therapeutics

Unit level (MQF): 4

Credits: 6

Unit Description

Medical therapeutics is a branch of medical science which deals with the application of remedies to heal diseases leading to recovery. In the sequence of events, therapeutics follows diagnosis, since the cause must be first identified in order to rectify the situation. Therapeutics can also be used to prevent sickness or a condition from occurring.

Once the scope to carry out a therapy is defined, then it is important that the patient, from a medical perspective, completes the whole treatment. Different types of therapies are applied for different conditions. A simple example is a person who is suffering from asthma – when the symptoms occur an inhaler is used to soothe the patient. Therefore, the inhaler is the therapeutic device used for to treat an asmathic condition. On the other end of the spectrum, a patient who has been diagnosed with cancer must undergo radiotherapy in order to kill the turmeric cells. Performing radiotherapy is a profession in itself, and requires a number of skilled personnel. Therefore, the grades of therapeutic solutions available are vast, in complexity of use, in treatment cost and in the number of people required to perform the treatment.

This module will focus on various types of therapeutic methods, and their relation to engineering. Starting from the most basic level, that of swallowing a pill, and followed by other methods such as cochlear implants and rehabilitation equipment, the module will end with radiotherapy and nuclear medicine application in therapeutics.

Learning Outcomes

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

1. *Understand what therapeutics entails and the role of the biomedical engineer.*
2. *Have a thorough understanding of various types of therapeutic devices and their principles of operation.*
3. *Be able to outline the building blocks of these therapeutic devices.*
4. *Understand the functionality and limitations of each device.*
5. *Understand the health and safety issues related to each therapeutic device and process.*

Unit: ETWEB-406-1502 - Internet Technologies and Web Design

Unit level (MQF): 4

Credits: 6

Unit Description

This unit prepares learners to work effectively in many business and technology-related career and is primarily intended to prepare learners for a junior web developer role.

First, learners will be introduced to essential networking technologies and skills that are important for all professionals who use the Internet. Learners will be familiar with simple network troubleshooting and network security. Furthermore, learners will be introduced to cloud computing technologies, such as: Software as Service, Platform as Service, and Infrastructure as Service. Learners will be introduced to the configuration and the effective use of popular web client applications and different Web 2.0 technologies.

Next, the unit will introduce learners to essential Web page development concepts. They will develop Web sites using Hypertext Markup Language (HTML5 or a similar markup language) and Cascading Style Sheets (CSS). Furthermore, learners will be introduced to working with images, create hyperlinks, and add tables, forms, video and audio.

In addition, learners will be introduced server side programming. Learners will be familiar with basic syntax of PHP and will learn how to embed PHP inside HTML pages, how to create and validate web forms. Also, they will learn how to organize the files required building a dynamic web application, and how to read and write data to/from files.

Other topics introduced will include validating HTML and CSS code, using style sheets extensively to format Web page content, implementing fundamental design concepts and website publishing.

Learning Outcomes

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

1. *Understand the concept of Internet Technologies.*
2. *Build and publish static and dynamic websites to a given specification.*
3. *Alter the visual style of a website through the use of CSS.*

Unit: ETNET-406-1508 - Routing Basics (CCNA 2)

Unit level (MQF): 4

Credits: 6

Unit Description

The purpose of this unit is to provide learners with the basic knowledge and understanding of the routing and switching technologies underlying contemporary network infrastructures and to enable them to acquire practical skills in the configuration and maintenance of these devices.

The unit delivers the knowledge and skills required to cover the matched curriculum of Cisco Certified Network Associate (CCNA) Routing and Switching course.
Computer Networking technologies have grown in complexity to meet the need of modern Business solutions. This unit presents learners with the business drivers for and the underlying technologies to support integrated voice and data capabilities in a secure network environment.

In addition to studying the theoretical aspects of contemporary routing protocols such as OSPFv3 the unit involves a significant element of hands-on lab-oriented activities and simulation package exercises using industry standard equipment.

The course can be delivered through a 'blended learning approach' where tutor led teaching is combined with media rich online learning resources.

If delivered in conjunction with its related Cisco CCNA semesters, this unit can prepare learners for the Cisco 200-120 examination.

Learning Outcomes

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

1. *Describe switching protocols and concepts.*
2. *Implement basic switch configuration and security.*
3. *Describe routing protocols and concepts.*
4. *Implement basic router configuration and security.*
5. *Describe and configure Network Address Translation (NAT).*
6. *Describe and Configure DHCP.*

Unit: ETELX-406-1516 - Applications of Power Electronics in Electrical Motor Drive Systems

Unit level (MQF): 4

Credits: 6

Unit Description

This unit has been designed to develop candidates' knowledge, understanding and skills in a range of power electronic circuitry used in electrical motor speed and torque control.

The widespread use of power electronics in industry, commerce and even the home has led to the precision control of speed and torque on a range of electrical motors. This Unit has been written in conjunction with Power Electronics Units to provide the student with a comprehensive study of power electronics and motor speed control.

In the first part of the Unit we will review what has been covered in Power Electronics Units more specifically what has been studied in relation to both single–phase and three-phase converters, a.c. to a.c. regulators and inverters particularly as these are applied to motor speed control, before going on to consider three-phase converters.

Students will also be provided with an opportunity to consolidate their knowledge, understanding and skills in power electronics and electrical motor drives by undertaking an investigation into the operation and performance of an electronically controlled motor speed control system.

The unit focuses on the knowledge and understanding required in electrical motor drive systems at both a systems level and at individual component level.

The presentation of this Unit is suitable for students wishing to further careers within electrical or electronic engineering This Unit has been designed to incorporate sufficient time to allow lecturers to teach all of the Motor Drive Theory and electrical motor speed control content contained in the Unit. There is also sufficient time for candidates to practice what they have learnt through appropriate formative assessment exercises and practical laboratory work.

With regard to practical work, it is strongly recommended that candidates are allowed to undertake a practical laboratory on at least some of the electronic drive circuitry identified in the Outcomes. This will help candidates relate theory to practice. The use of computer simulation software, either along with the practical laboratory work, or on its own will also assist candidate learning.

Visits to industrial or commercial premises where motor drive circuits are prevalent will assist in the student familiarizing themselves within an industrial environment with the content of this Unit.

This Unit may also be studied individually or incorporated within a Group Award.

Learning Outcomes

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

1. *Explain the operation and applications of single-phase converters and ac to ac regulators.*
2. *Explain the operation of D.C. chopper circuits.*
3. *Explain the operation of three-phase converters and their associated circuits.*
4. *Explain the operation of inverters with reference to the D.C. link particularly in relation to voltage source, current source, PWM and PAM methods.*
5. *Investigate the operation and performance of an electronically controlled motor speed control system.*

Unit: ETELE-406-1805 - Authorisation A part 2

Unit level (MQF): 4

Credits: 6

Unit Description

This unit starts by looking at the fundamental laws of magnetism and then continue on to simple transformers, where one will be led to understand the principles of operation. The student will look into simple construction details of core and shell type transformers. The concepts underpinning the transformer's operations will be essential for the learner to understand the principles of operation of various electrical and electromechanical devices.

Different cable systems will be looked into and practiced to give the student knowledge in industrial installations, such as small garages and workshops. Earthing and bonding will also be practiced during these practical tasks. Earthing will then be discussed in more detail in further units.

The next topic will then be to look into protective gear where the student will look into various types of over-current protection, earth leakage protection and overvoltage protection.

The unit will finally conclude by looking at micro-renewable energies, efficiencies of appliances and buildings.

Learning Outcomes

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

1. *Use electrical and magnetic principles to understand transformer principles*
2. *Install different cable systems for garages and small workshops.*
3. *Apply the operating principles of different protective devices in circuits` protection design.*
4. *Understand modern efficient technologies available for use.*

Unit: ETELX-406-1803 - Advanced PCB Design

Unit level (MQF): 4

Credits: 6

Unit Description

The printed circuit board (PCB) has become the foundation of every electronic device from smartphone, modem to smart devices. A modern PCB needs to be small, flexible, yet able to carry signals at a high speed, remove heat generated by components efficiently and does not interfere with other devices. PCB design is both an art and a science. It is an art because of the creativity in the design and a science because of the calculated manipulations of its physical properties. The module *'Electronic Circuit manufacture'* is a prerequisite and the learner should have gotten a pass to successfully read this unit.

Simulation allows a number of parameters to be tested and tuned before actual fabrication. The earlier errors are caught the quicker the process to produce a working project. In this unit both more complex analog and digital circuits are simulated. For manufacturing purposes, a Bill of Materials (BOM) has to be drawn up and the availability of components checked. Learners need to appreciate the difference between one-off or prototype construction and production methods. Learners are also introduced to the concept of assembly variants where a single PCB is used to for number of variations.

After simulation the circuit needs to be prepared for the layout. Connectors and test points are added as necessary and footprints are selected. After the learner is introduced to the layout process starting with the Design Rule Checks (DRC). Both manual routing and auto-routing are covered, and many complex designs simply cannot be routed by manually.

As system complexity increases the PCB needs to follow suit. There are an increasing number of applications which require specialized design techniques for example multiplayer boards, special laminates or routing techniques. A PCB design technician has to be aware of these techniques and apply them successfully. The PCB designer needs to be aware of Electromagnetic Compatibility (EMC) issues when designing the PCB.

A significant number of PCB's are generated by specialized companies, so the final artwork has to conform to the design house rules. A PCB technician has to be know such rules and see that the design conforms to them.

Learning Outcomes

Upon completing the unit, learners should be able to:

1. *Verify correct circuit operation by the use of simulation.*
2. *Design a PCB to a set of requirements.*
3. *Apply specialised techniques in PCB design.*
4. *Prepare a PCB for manufacturing.*

Unit: ETELX-406-1824 - Advanced PCB Manufacturing

Unit level (MQF): 4

Credits: 6

Unit Description

This unit aims to give learners an understanding of the process involved in the manufacturing of electronic circuits. It is delivered with a high practical content which will build learners' confidence in their ability to construct, assemble and perform electrical tests of an electronic printed circuit board. The learners are first introduced to the different types of electronic devices which form the building blocks of electronic circuits. They study the reason why these electronic circuits and components are used, their structure, their operation, the way in which they are differentiated from each other and their application.

Learners will also be introduced to the conventions associated with the layout of electronic schematics and the communication of engineering procurement information via Bills of Materials. Once they have a firm grasp of the main electronic devices, the learners are introduced to the anatomy of a printed circuit board, followed by the various steps in a PCB manufacturing process. Through practical hands-on exercises learners will then examine in detail how to apply the various PCB manufacturing steps.

Learners will then move onto learning the principles behind the layout of multi-layer Printed Circuit Boards and their electrical, mechanical properties. The learners will then manufacture various printed circuit boards, populate them with through-hole and surface mount devices and perform the required tests checks so to identify and quality issues. They will have the opportunity to use electronics soldering equipment and hand tools to construct and troubleshoot electronic circuit boards. Additionally, learners will have the opportunity to apply various IPC standards and checklists related to PCB manufacturing and assembly.

Learning Outcomes

Upon completing the unit, learners should be able to:

1. *Identify and describe electronic components regarding the circuit schematic symbols.*
2. *Understand the PCB anatomy and its properties.*
3. *Describe the process of PCB manufacturing and quality issues.*
4. *Manufacture and assemble a PCB based electronic circuit.*

Unit: ETMTH-406-1801 - Maths for Engineering Degree

Unit level (MQF): 4

Credits: 6

Unit Description

This unit builds upon the mathematical tools learned in Mathematics for Engineering to provide the learner with a wider range of mathematical techniques. Moreover, these techniques are applied to solve engineering problems. Therefore, it is assumed that the learner has successfully completed this unit prior to commencing Maths for Engineering Degree.

The first learning outcome will provide the skills necessary to analyse numerical data using simple statistical techniques such as the mean and standard deviation. It also illustrates how to create and use histograms and cumulative frequency curves to determine the mean, median, mode and standard deviation of grouped data. The use of spreadsheet software to determine statistical techniques is also shown. It also introduces power series functions and arithmetic and geometric series.

Learning outcome two, outlines the skills required to add, subtract, multiply and divide complex numbers in rectangular and polar form. This knowledge gives the learner the ability to use phasors and complex numbers in engineering applications.

The underpinning knowledge of proving trigonometric identities in learning outcome three provides the learner with further trigonometric techniques to be able to analyse simple waveforms. Spreadsheets are again utilised in this outcome.

The fourth learning outcome provides the learner with the knowledge, understanding and the ability to apply differential and integral calculus to Engineering problems.

LEARNING OUTCOMES

Upon completing the unit, learners should be able to:

1. *Use statistical techniques to represent and analyse data in the engineering context.*
2. *Manipulate Complex Numbers to represent signals related to engineering applications.*
3. *Use trigonometric identities to solve trigonometric equations in engineering context.*
4. *Use differential and integral calculus to solve real engineering problems.*