MCAST

MQF Level 4

EE4-01-21

Advanced Diploma in Robotics, Drone Design, Automation and Artificial Intelligence

Course Description

This course presents learners with introductory knowledge about artificial intelligence and machine-learning techniques, followed by automation systems, robots, and drone functionality. Learners will have the opportunity to use various AI hardware and software tools to control a range of input and output devices, apply various forms of signal conditioning, use embedded systems and apply communication standards. Through practical experiments, this course is structured in a way that supports learners in understanding the operational characteristics and concepts of drones, automation and robotic systems. Additionally, students are guided to develop the skills required to design, install, troubleshoot, maintain and programme such systems.

Programme Learning Outcomes

At the end of the programme the student is able to:

1. *Program an industrial robotic, automation and drone system.*
2. *Recognise the purpose, functionality and need of a robotic, drone and automation system.*
3. *Construct and test analogue and digital electronic circuits to the required specification.*
4. *Apply and use 3D technologies for an engineering system.*
5. *Understand the basic principles of machine learning techniques and Artificial Intelligence for a specific application.*

Entry Requirements

MCAST Level 3 Diploma in the fields of Engineering, Science or ICT

or

4 SEC/O-Level/SSC&P (Level 3) passes Compulsory: Mathematics or Physics

Key Information

Awarding Body – MCAST

Accreditation Status – Accredited via MCAST's Self Accreditation Process (MCAST holds Self-Accrediting Status as per 1st schedule of Legal Notice 296/2012)

Type of Programme: Qualification

MQF Level	Examples of Qualifications	'Qualification' Minimum Credits Required	'Award' Credits Required
Level 8	Doctoral Degree Third Cycle Bologna Process	NA	NA
Level 7	Masters Second Cycle Bologna Process	90-120	Less than 30
	Post-Graduate Diploma	60	
	Post-Graduate Certificate	30	
Level 6	Bachelor[23]/Bachelor (Hons.)[24] First Cycle Bologna Process	180-240	Less than 180
Level 5	Short Cycle Qualification	120	Less than 60
	Undergraduate Higher Diploma	90	
	Undergraduate Diploma	60	
	Undergraduate Certificate	30	
	VET Level 5 Programme[25]	60-120	
Level 4	Pre-Tertiary Certificate	30	Less than 120
	VET Level 4 Programme[26]	120	
	MATSEC Certificate	NA	
Level 3	VET Level 3 Programme[27]	60	Less than 60
	General and Subject Certificate	NA	
Level 2	VET Level 2 Programme[28]	60	Less than 60
	General and Subject Certificate	NA	
Level 1	VET Level 1 Programme[29]	40	Less than 40
	General and Subject Certificate	NA	
Introductory Level A	Preparatory Programme	30	Less than 30
Introductory Level B	Pre-entry Basic Skills Course	30	Less than 30

Table 1: Minimum number of credits for 'Qualifications' and parameters for 'Awards'

Fig.1: p56, Ministry for Education and Employment & National Commission for Further and Higher Education Malta (2016). *Referencing Report, 4th Edition*. NCFHE.

Total number of Hours: 3000 hours

Mode of attendance: Fully Face-to-Face Learning

Duration: 2 Years

Target audience for MCAST full-time courses is 16 to 65+

The official language of instruction at MCAST is English. All notes and textbooks are in English (except for language courses, which will be in the respective language being instructed). International candidates will be requested to meet English language certification requirements for access to the course.

This course will be offered at

MCAST has four campuses as follows:

MCAST Main Campus
Triq Kordin, Paola, Malta

All courses except for the Institute for the Creative Arts, Centre of Agriculture, Aquatics and Animal Sciences are offered here.

Institute for the Creative Arts
Mosta Campus
Misraħ Għonoq Tarġa Gap,
Mosta

Institute of Applied Sciences,
Centre of Agriculture, Aquatics and Animal Sciences,
Luqa Road, Qormi

Gozo Campus
J.F. De Chambray Street
MCAST, Għajnsielem
Gozo

Teaching, Learning and Assessment

The programmes offered are vocational in nature and entail both theoretical lectures delivered in classes as well as practical elements that are delivered in laboratories, workshops, salons, simulators as the module requirements dictate.

Each module or unit entails a number of in person and/or online contact learning hours that are delivered by the lecturer or tutor directly (See also section 'Total Learning Hours).

Access to all resources is provided to all registered students. These include study resources in paper or electronic format through the Library and Resource Centre as well as tools, software, equipment and machinery that are provided by the respective institutes depending on the requirements of the course or module.

Students may however be required to provide consumable material for use during practical sessions and projects unless these are explicitly provided by the College.

All Units of study are assessed throughout the academic year through continuous assessment using a variety of assessment tools. Coursework tasks are exclusively based on the Learning Outcomes and Grading Criteria as prescribed in the course specification. The Learning Outcomes and Grading Criteria are communicated to the Student via the coursework documentation.

The method of assessment shall reflect the Level, credit points (ECTS) and the schedule of time-tabled/non-timetabled hours of learning of each study unit. A variety of assessment instruments, not solely Time Constrained Assignments/Exams, are used to gather and interpret evidence of Student competence toward pre-established grading criteria that are aligned to the learning outcomes of each unit of the programme of study.

Grading criteria are assessed through a number of tasks, each task being assigned a number of marks. The number of grading criteria is included in the respective Programme Specification.

The distribution of marks and assessment mode depends on the nature and objectives of the unit in question.

Coursework shall normally be completed during the semester in which the Unit is delivered.

Time-constrained assignments may be held between 8 am and 8 pm during the delivery period of a Unit, or at the end of the semester in which the Unit is completed. The dates are notified and published on the Institute notice boards or through other means of communication.

Certain circumstances (such as but not limited to the Covid 19 pandemic) may lead Institutes and Centres to hold teaching and assessment remotely (online) as per MCAST QA Policy and Standard for Online Teaching, Learning and Assessment (Doc 020) available via link https://www.mcast.edu.mt/college-documents/

The Programme Regulations referenced below apply. (DOC 004 available at: link https://www.mcast.edu.mt/college-documents/)

Total Learning Hours

The total learning hours required for each unit or module are determined as follows:

Credits (ECTS)	Indicative contact hours	Total Student workload (hrs)	Self-Learning and Assessment Hours
1	5 – 10 hrs	25 hrs	20-15 hrs*
2	10 – 20 hrs	50 hrs	40-30 hrs*
3	15 – 30 hrs	75 hrs	60-45 hrs*
4	20 – 40 hrs	100 hrs	80-60 hrs*
6	30 – 60 hrs	150 Hrs	120-90 hrs*
9	45 – 90 hrs	225 hrs	180-135 hrs*
12	60 – 120 hrs	300 hrs	240-180 hrs*

* The 'Self-Learning and Assessment Hours' amount to the difference between the contact hours and total student workload.

Grading system

All MCAST programmes adopt a learner centred approach through the focus on Learning Outcomes. The assessment of MCAST programmes is criterion-referenced and thus

assessors are required to assess learners' evidence against a pre-determined set of Learning Outcomes and assessment criteria.

For a student to be deemed to have successfully passed a unit, a minimum of 50% (grade D) must be achieved. In case of part time programmes, the student must achieve a minimum of 45% to successfully pass the unit.

All units are individually graded as follows:
A* (90-100)
A (80-89)
B (70-79)
C (60-69)
D (50-59)
Unsatisfactory work is graded as 'U'.

Work-based learning units are graded on a Pass/Fail basis only.

Detailed information regarding the grading system may be found in the following document: DOC 004 available at: link https://www.mcast.edu.mt/college-documents/

Intake Dates

•MCAST opens calls for application once a year between July and August of each year for prospective applicants residing in MALTA.
•Applications to full-time courses from international students not residing in MALTA are accepted between April and Mid-August.
•For exact dates re calls for applications please follow this link https://www.mcast.edu.mt/online-applications-2/

Course Fees

MCAST course are free for Maltese and EU candidates. International candidates coming from outside the EU need to pay fees for the respective course. Course fees are set on a per-level and course duration basis. For access to course fee structure and payment methods please visit https://www.mcast.edu.mt/fee-payments-for-non-eu-candidates/.

Method of Application

Applications to full-time courses are received online via the College Management Information System. Candidates can log in using Maltese Electronic ID (eID) or European eIDAS (electronic identification and trust services) to access the system directly and create an account as the identity is verified electronically via these secure services.

Non-EU candidates need to request account creation though an online form by providing proof of identification and basic data. Once the identity is verified and the account is created the candidate may proceed with the online application according to the same instructions applicable to all other candidates.

Non-EU candidates require a study visa in order to travel to Malta and joint the course applied for. For further information re study-visa please access https://www.identitymalta.com/unit/central-visa-unit/.

For access to instructions on how to apply online please visit https://www.mcast.edu.mt/online-applications-2/

Contact details for requesting further information about future learning opportunities:

MCAST Career Guidance
Tel: 2398 7135/6
Email: career.guidance@mcast.edu.mt

Current Approved Programme Structure

Unit Code	Unit Title	ECTS	Year	Semester
ETSFT-406-2000	Python with Raspberry Pi	6	1	YEAR
ETRBS-406-2000	Artificial Intelligence for Robots	6	1	YEAR
ETDSN-406-2002	Computer-Aided Design and 3D printing	6	1	YEAR
ETE&E-406-2000	Electrical, Mechanical, and Fluid Systems	6	1	YEAR
ETRBS-406-2001	Robot Programming	6	1	YEAR
ETENG-406-2000	Sensors and Signal Conditioning	6	1	YEAR
ETRBS-404-2002	Robot Mechanisms and Manipulators	4	1	YEAR
ETRBS-403-2003	Panel Building	3	1	YEAR
ETPRJ-405-2003	Drone and Robot Building - Project Based	5	1	YEAR
CDKSE-406-1901	Mathematics for Electrical Engineering	6	1	YEAR
CDKSK-406-2001	English	6	1	YEAR
ETRBS-406-2004	Industrial Communication Protocols	6	2	YEAR
ETRBS-406-2005	PLC Equipment	6	2	YEAR
ETH&S-403-1801	Health and Safety	3	2	YEAR
ETRBS-403-2006	Troubleshooting, Inspection and Testing	3	2	YEAR
ETRBS-406-2007	Motors for Robotic Systems and Drones	6	2	1
ETRBS-406-2008	C Programming for Microcontrollers	6	2	YEAR
ETRBS-406-2009	Industrial Motors and Drives	6	2	2
ETRBS-406-2010	Feedback Systems	6	2	YEAR
ETPRJ-406-2004	Final Year Project	6	2	YEAR
CDKSK-406-2014	IT for Robotics	6	2	YEAR
CDKSK-404-1915	Employability and Entrepreneurial Skills	4	2	1
CDKSK-402-2104	Community Social Responsibility	2	2	YEAR
Total ECTS		120	/	/

ETSFT-406-2000: Python with Raspberry Pi

Unit Level (MQF/EQF): 4
Credits: 6
Delivery Mode: Face-to-Face Learning
Total Learning Hours: 150

Unit Description

Python Programming is well-known in various engineering fields. This unit will expose the student to the basic principles of Python Programming so to support other units. Through practical programming labs, this unit is structured in a way to support learners in understanding the underlying concepts and basic elements of python programming language, for example Branching Programs, Control Structures, Strings and Input and Iteration. It will specifically then delve into mutability and higher order functions, simple algorithms, data structures. Other advanced topics include the implementation of encryption and decryption, classical cyphers, Gaming and GUI programming for drawing using Turtle, Tkinter, and others. Additionally, using Raspberry PI learners will be given the opportunity to apply networking and multithreaded programming, use of Sockets, Threads and Processes. 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 learner will be able to:

1. *Understand the basic elements of python, branching programs, control structures, strings and iteration*
2. *Apply functions and scoping, recursion, Ffiles and system functions.*
3. *Understand structured types, mutability and higher-order functions, classes and object-oriented programming concepts.*
4. *Apply appropriate software testing and debugging strategies.*
5. *Program an advanced python graphics and GUI application.*

ETRBS-406-2000: Artificial Intelligence for Robots

Unit Level (MQF/EQF): 4
Credits: 6
Delivery Mode: Face-to-Face Learning
Total Learning Hours: 150

Unit Description

Artificial intelligence is arguably the most exciting field in robotics, since it provides machines with the ability to learn from experience without the need of explicit programming in order to perform cognitive functions. This unit attempts to build learning machines and artificial intelligence applications with programs that are as simple as possible. The main advantage is that the algorithmic behaviour can be easily understood and applied through practical hands on exercises.

Additionally, the delivery of this unit shall be focused on a project-based approach so to implement and use several artificial intelligence techniques such as expert system, neural network, cellular automata, genetic algorithm, and roulette brains. Learners will be exposed to the basic methods in Artificial Intelligence, all with a focus on robotics. Extensive microcontroller programming examples and assignments will apply these methods in the context of building various AI robotic systems. 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 learner will be able to

1. *Describe the basics and types of machine learning techniques.*
2. *Understand artificial intelligence and machine learning techniques.*
3. *Use artificial intelligence and machine learning techniques for a robotic application.*
4. *Construct the software and hardware for an artificially intelligent robotic system.*

ETDSN-406-2002: Computer-Aided Design and 3D Printing

Unit Level (MQF/EQF): 4
Credits: 6
Delivery Mode: Face-to-Face Learning
Total Learning Hours: 150

Unit Description

This unit is a hands-on 3D modelling class that starts from the basics of 2D sketching and proceeds to give the required knowledge such that the learner is able to create 3D models. Assemblies consisting of several 3D parts will also be developed together with the respective drawings including dimensioning.

Mechanical fixtures and designs will be tested in simulation such that the structure is analysed for stresses and strains, load bearing and also modes of vibration before manufacturing. Once the final design is arrived at, the 3D model will be prepared for 3D printing. Once the 3D model is finalised the learner requires only some extra skills to be able to go for 3D printing.

Through a hands-on project the learners will discover for themselves the potential and limitations of 3D printing. No previous knowledge is required except for a touch of creativity.

Learning Outcomes

On Completion of this unit the learner will be able to

1. *Create 2D sketching and 3D operations in a solid modelling software suite.*
2. *Generate assemblies of parts and their respective drawings.*
3. *Perform basic FEA (modal and static) and convergence studies using 3D printed materials.*
4. *Operate slicer software to create the necessary layers, supports for STL generation.*
5. *Create Post-Process STL files for 3D printing and the 3D printing process.*

ETE&E-406-2000: Electrical, Mechanical, and Fluid Systems

Unit Level (MQF/EQF): 4
Credits: 6
Delivery Mode: Face-to-Face Learning
Total Learning Hours: 150

Unit Description

This unit delivers the underpinning knowledge that a student requires such that problems arising in the mechatronics engineering area can be analysed and dealt with effectively. The unit covers four different engineering areas, specifically, the basics of electrical and electronic components and corresponding circuits and also the areas concerning the mechanical and fluid domains.

Basic passive electrical components and their function within electrical circuit systems will be reviewed and analysed. Active electronic components as used in electronic circuit boards will also be taught through a practical approach involving circuit prototyping and testing. Simple mechanical systems will be reviewed, analysed and tested experimentally such that theoretical results are confirmed with experiments. Similarly, the basic principles of fluid statics and dynamics will be reviewed theoretically and tested under experimental conditions.

Learning Outcomes

On completion of this unit, the learner will be able to:

1. *Describe basic electrical components and circuits.*
2. *Describe basic electronic components and circuits.*
3. *Demonstrate basic mechanical concepts underlying simple mechanical systems.*
4. *Demonstrate basic fluid statics and dynamics concepts underlying simple fluid dynamic systems.*

ETRBS-406-2001: Robot Programming

Unit Level (MQF/EQF): 4
Credits: 6
Delivery Mode: Face-to-Face Learning
Total Learning Hours: 150

Unit Description

The practice of robotics involves the art, and the know-how of designing, applying and using robots in the human activities. Robots may be used in manufacturing environments, in space exploration and underwater applications. A robotic system consists of various devices and systems connected with the robot. This unit allows learners to program robots in several different ways including teach, continuous walk-through and software modes, using appropriate robot programming languages. Additionally, the delivery of this unit shall be focused on a project-based approach so to simulate and program any robotic application.

Through practical hands-on experiments learners will have the opportunity to generate robot programs for any kind of robot controller.

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 learner will be able to:

1. *Describe robot components, characteristics and applications.*
2. *Understand the robot reference frames, and programming modes.*
3. *Generate the program for a specific industrial robot controller and application.*
4. *Use robot libraries to simulate a specific robotic application.*
5. *Export and offline program any robot controller.*

ETENG-406-2000: Sensors and Signal Conditioning

Unit Level (MQF/EQF): 4
Credits: 6
Delivery Mode: Face-to-Face Learning
Total Learning Hours: 150

Unit Description

This unit aims to provide the learner with the fundamental knowledge required to understand the characteristics and successfully operate electronic sensors in robotic, drone and automated systems. The differences between analogue and digital sensors will be presented and the specific requirements to interface with digital controllers identified. This unit will review a wide variety of electrical and mechanical electronic-based sensors.

The unit also focuses on the use of active operational amplifier circuits to improve the signal-to-noise ratio of the transducers before discretisation. Basic electronic building blocks for signal conditioning will be studied and implemented through practical prototyping and testing. Learners will also learn the importance of the different types of isolation to isolate the sensor side from the low voltage electronics in line with modern electronic design practices.

Due to the miniaturisation of electromechanical sensors, the use of printed circuit boards to connect sensors to other electronic components is required. Hence, learners will be taught to use industry-standard schematic design and printed circuit board layout software to implement designs. Through this unit, learners should be capable of designing simple multi-layer circuit boards and be familiar with the fabrication processes.

Learning Outcomes

On completion of this unit, the learner will be able to:

1. *Distinguish between Analogue and Digital Sensors.*
2. *Describe the operation and characteristics of a wide range of Electronic Sensors.*
3. *Demonstrate operational amplifier-based signal conditioning circuits.*
4. *Explain isolation techniques in electronic measurement and drive circuits.*
5. *Perform schematic and printed circuit board design tasks.*

ETRBS-404-2002: Robot Mechanisms and Manipulators

Unit Level (MQF/EQF): 4
Credits: 4
Delivery Mode: Face-to-Face Learning
Total Learning Hours: 100

Unit Description

This unit is a foundation course in mechanisms and robots. After a brief introduction on the subject matter and terms the motion properties of mechanisms including degrees of freedom, velocity and acceleration will be presented. Design constraints and motion analysis for the robotic systems will be first performed in a simulated environment. Eventually a prototype robotic arm with a small number of degrees of freedom would be assembled from scratch and also programmed to perform specific trajectories.

The learners would learn how 3D printing can be used to manufacture fixtures for robotic arms, will learn assembly of mechatronics systems and also programming through the final project task. Building from scratch a robotic arm would give a clear picture of all the challenges and problems that robotic systems have and will also clarify the forward and inverse kinematics concepts.

Learning Outcomes

On Completion of this unit the learner will be able to

1. *Recognise different joints, kinematic forms, mobile vs fixed with end-effectors.*
2. *Compare Cartesian, Cylindrical and Polar Coordinate systems.*
3. *Simulate a robot in a robotic simulation environment.*
4. *Build a robotic arm from scratch using 3D printed parts for fixtures.*
5. *Programme a robotic arm to follow required trajectory and analyse the working envelope.*

ETRBS-403-2003: Panel Building

Unit Level (MQF/EQF): 4
Credits: 3
Delivery Mode: Face-to-Face Learning
Total Learning Hours: 75

Unit Description

In order for an automation and robotic system to be functional, it must connect to the "real world", which involves wiring digital, analogue and specialized field devices. This unit covers the connections and other installation issues such as power distribution and control panel layout. Physical input and output modules provide the physical interface between the system controller and the field devices such as lamps, switches, stacked lights and actuators. Through practical hands-on wiring and installation exercises learners will be able to understand how I/O interfaces provide isolation, voltage levels, ground loops, noisy electrical signals from interfering with the controller operation. Additionally, during the practical installation exercises, learners will learn about the various types of grounds (safety ground, clean grounds, dirty grounds), importance of fuses and circuit breakers and EMI suppression, various enclosure types, and the application of well-designed control panel interior and exterior through the proper placement of components.

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 learner will be able to:

1. *Apply wire routing guidelines to reduce noise coupling.*
2. *Illustrate a typical layout of an operator control station and panel specification.*
3. *Describe various enclosure standard types and their construction.*
4. *Apply correctly control wiring practices to construct I/O panels.*
5. *Discuss the importance of various protection device.*

ETPRJ-405-2003: Drone and Robot Building - Project Based

Unit Level (MQF/EQF): 4
Credits: 5
Delivery Mode: Face-to-Face Learning
Total Learning Hours: 125

Unit Description

Most engineering projects carried out today are team efforts. The complexity of modern engineering needs the contribution of several knowledge domains. Working in team requires extra skills than doing an individual project. It is important that these skills are transferred and homed 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.

This unit will be assessed by looking at individual work and also teamwork. Each group will consist of 3-4 learners. Marks are awarded both for the planning and technical aspect.

Learning Outcomes

On completion of this unit the learner 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. *Demonstrate theoretical underpinning knowledge of reflective practice in written form and present coherent arguments.*
4. *Demonstrate the project's final achievements when compared to the project specification.*
5. *Produce a project report addressing sections in line with a provided template.*

ETRBS-406-2004: Industrial Communication Protocols

Unit Level (MQF/EQF): 4
Credits: 6
Delivery Mode: Face-to-Face Learning
Total Learning Hours: 150

Unit Description

Industrial networking training is essential in today`s networked world. Protocols are a set of rules and conventions used for communication of entities in different systems. Protocols are necessary because of the task of exchanging information between devices. Different types of protocols are used for industrial communication. This unit gives an overview of the industrial communication networks available such as PROFIBUS (DP, PA, PROFINET), Modbus, RS232/RS485/RS422, CIP-related protocols e.g. Ethernet/IP and DeviceNet. Additionally, various networking topologies, standards and media access are taken into considered. Through practical hands-on experience learners will be able to understand the general communication network concepts of typical standards, specifications and proprietary factory networks. Learners will be given the opportunity to implement various microcontroller-based, PLC-to-PLC communications, and master/slave bus arbitration protocols. Additionally, through practical hands-on exercises learners will be able to understand various message forms, categories, cache connections and communication standards for peer-to-peer communications.

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 learner will be able to

1. *Explain the general communication network concepts.*
2. *Describe typical factory communication networks.*
3. *Describe the main features of standard and proprietary factory networks.*
4. *Apply communication protocols using a specific controller.*
5. *Distinguish between different types of protocols used in electronic communication.*

ETRBS-406-2005: PLC Equipment

Unit Level (MQF/EQF): 4
Credits: 6
Delivery Mode: Face-to-Face Learning
Total Learning Hours: 150

Unit Description

Industrial Automation technologies are widely used in today's process and manufacturing industries. The main objective is to improve productivity with minimal human intervention. The unit starts by focusing on the functions of logic gates and describes the basic elements involved with programmable logic controller. Additionally, learners will have the opportunity to familiarize with various PLC instructions (e.g. timer and counter), signals such as digital and analogue, their resolution and relationships, a range of input and output devices.

On completion of the unit learners will know about various types of control systems and their utilisation in the industrial world. Through practical hands on exercises, learners will be able to write simple PLC programs using IEC 61131-3 standards and identify the errors in the programs that affect the execution of the programs. Learners will be given the opportunity to perform practical work using the available PLC systems.

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 learner will be able to

1. *Understand comparison and computation instructions.*
2. *Control and wire various types of sensors, actuators and their applications.*
3. *Write PLC ladder logic programs for various sequential applications.*
4. *Discuss the operational characteristics of programmable logic controllers.*
5. *Use various IEC 61131-3 programming languages.*

ETH&S-403-1801: Health and Safety

Unit Level (MQF/EQF): 4
Credits: 3
Delivery Mode: Face-to-Face Learning
Total Learning Hours: 75

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 learners. 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 learner's understanding of how these requirements are applied in the workplace.

Learning Outcomes

On completion of this unit the learner 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.

ETRBS-403-2006: Troubleshooting, Inspection and Testing

Unit Level (MQF/EQF): 4
Credits: 3
Delivery Mode: Face-to-Face Learning
Total Learning Hours: 75

Unit Description

This unit provides practical training for learners in troubleshooting, inspection and testing of electrical, electronic and mechanical systems and sub-systems as commonly found in robotic, drone and industrial automation equipment. The skills learnt in this unit are essential for the maintenance and repair of electromechanical equipment, as seen in several applications.

Learners will be taught about the different electrical, and electronic-based test instruments which are commonly used in industry through practical exercises carried out on electronic and electromechanical equipment. Learners will also learn about safety considerations to be taken when testing and inspecting equipment. By the end of the unit, learners should be able to independently carry out inspections through testing, identify problems and implement timely solutions.

Learning Outcomes

On Completion of this unit the learner will be able to

1. *Describe the operation of various Electrical Test Instruments.*
2. *Describe the operation of various Electronic Test Instruments.*
3. *Understand safety considerations when testing and inspecting electromechanical equipment.*
4. *Perform inspection, testing and troubleshooting of electrical/electronic equipment.*
5. *Perform generic electro-mechanical inspection.*

ETRBS-406-2007: Motors for Robotic Systems and Drones

Unit Level (MQF/EQF): 4
Credits: 6
Delivery Mode: Face-to-Face Learning
Total Learning Hours: 150

Unit Description

This unit aims to provide the learner with the fundamental knowledge required to understand the characteristics and successfully operate a variety of electrical machines. Electrical machines are the fundamental building blocks in robotic, drone and automation systems used to provide linear/rotational torque and motion. The most commonly used types of machines for small to medium power applications are studied in this unit including DC machines, Servo Motors, Stepper Motors and Brushless Machines.

Learners will learn about the construction, theory of operation and electronic drivers required for the aforementioned electrical machines. The unit is intended to be mostly taught with a practical approach where learners carry out different position and speed control tasks with digital controllers and electronic driver circuit boards. For the case of the brushless machine which is mostly used in drone technology, the learners will be engaged in wiring and interfacing a complete electrical/electronic system starting from the batteries and ending with the ESC-driven brushless motors.

Learning Outcomes

On Completion of this unit the learner will be able to

1. *Demonstrate the theory, operation and control of DC Machines.*
2. *Describe the operation and control of Servo Motors.*
3. *Describe the operation and control of Stepper Motors.*
4. *Analyse the theory, operation and interfacing of Brushless Motors.*
5. *Perform Motor Control for a Robotic Application.*

ETRBS-406-2008: C Programming for Microcontrollers

Unit Level (MQF/EQF): 4
Credits: 6
Delivery Mode: Face-to-Face Learning
Total Learning Hours: 150

Unit Description

A microcontroller is an integrated system containing a minimum of a microprocessor, dynamic and non-volatile memory, and a set of peripherals consistent with all design requirements. This unit allows learners develop C based programs on a microcontroller-based system. Additionally, through practical hands-on experiments learners will have the opportunity to develop and debug software programs for the control of various digital and analogue input, output devices. Additionally, will be exposed to use embedded IDE (Integrated Development Environment) to write the embedded code using a 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 LEDs and LCD displays, switches, keypads. Learners will be guided through a broad range of case studies in order to control various embedded I/O hardware and to incorporate a range of interesting transducers. Attention will also be given to the basic concepts on interrupt programming.

Learning Outcomes

On completion of this unit the learner will be able to

1. *Develop software and hardware for a specific microcontroller application.*
2. *Describe the basic I/O and memory architecture of a microcontroller-based system.*
3. *Demonstrate polling and interrupt programming techniques.*
4. *Practice program compilation, loading and running for a specific microcontroller application.*
5. *Use the standard C programming language to program a microcontroller.*

ETRBS-406-2009: Industrial Motors and Drives

Unit Level (MQF/EQF): 4
Credits: 6
Delivery Mode: Face-to-Face Learning
Total Learning Hours: 150

Unit Description

This unit aims to provide the learner with further knowledge of Electrical Machines to that learnt in the previous unit *Motors for Robotic Systems and Drones* for medium to high power ratings as used in industrial applications. Electrical Machines are the source of linear/rotational torque and motion in a wide range of speed applications. Typically, to optimise the performance of such machines, the drive includes a power converter and digital controller which carries out various functions.

The learner will gain further knowledge on DC machines, Induction Machines, and Permanent Magnet Machines within Industrial Electric Drive Applications by reviewing characteristic curves and power converter circuits. The basic current, speed and position control implementations for each of the machines will be considered and investigated using practical exercises.

The unit will also expose learners to different methods for industrial position control applications based on integrated and stepper motor drives. Various practical exercises and demonstrations will be carried out to enable learners to configure and operate a Variable Speed Different for different Electrical Machines.

Learning Outcomes

On completion of this unit the learner will be able to

1. *Discuss the application of DC Machines and Drives in industrial applications.*
2. *Discuss the application of Induction Machines and Drives in industrial applications.*
3. *Discuss the application of Permanent Magnet Machine Drives in industrial applications.*
4. *Discuss the application of Industrial Servos and Stepper Motors.*
5. *Perform practical tasks related to control of an Electrical Machine using a Variable Speed Drive.*

ETRBS-406-2010: Feedback Systems

Unit Level (MQF/EQF): 4
Credits: 6
Delivery Mode: Face-to-Face Learning
Total Learning Hours: 150

Unit Description

Feedback Systems is quite possibly the most important class a learner in engineering could ever take. Everything needs feedback. You will never design an electronic or an electromechanical system that does not include a feedback loop, either explicitly or implicitly. Every interface to the real world—whether you are building a robot arm, a temperature control system, an audio power amp, or an RF synthesizer (the list goes on and on)—needs to drive some kind of actuator (a motor, a heater, a power transistor, or an oscillator). To make sure that actuator is doing the right thing, you need to measure the output (its position, its temperature, its voltage, or its frequency) and compare that measurement to what you meant to do. In other words, you need feedback.

This unit is an introduction to design of feedback systems. Topics covered in the course include properties and advantages of feedback systems, how the response of feedback system is compared and improved using time-domain performance measures. Stability and degree of stability would be discussed together with ways to achieve them. At the core of this module a hands-on approach at introducing the PID algorithm and its implementation in software will be taken. The control of simple control system will be the final task that you will undertake, this will help pin down the essential knowledge such that all your robotic system would perform exactly as you need them.

Learning Outcomes

On completion of this unit the learner will be able to

1. *Distinguish between Open Loop and Closed Loop.*
2. *Understand feedback system response specifications and how to improve them.*
3. *Provide different control architectures as solutions to different control problems.*
4. *Program a PID routine in a hands-on task.*
5. *Understand the limitations of the PID and how to deal with problems in a control loop.*

ETPRJ-406-2004: Final Year Project

Unit Level (MQF/EQF): 4
Credits: 6
Delivery Mode: Face-to-Face Learning
Total Learning Hours: 150

Unit Description

The Final Year Project is intended to assess the learner's acquired knowledge and skills in developing a custom electromechanical solution to a given specification. During the development of the project, the learner is to research different components to fulfil system and sub-system requirements. Research is to be carried out diligently with reference to technical documents such as academic textbooks, technical datasheets and scientific papers. The learner should be capable of finding components which meet the requirements of his project and compare multiple solutions in terms of technical specifications and cost.

The project is to be an automated solution which consists of both sensors and actuators. The final system can be in the form of a robot, drone or industrial automation jig. The project should include electronic, electrical and mechanical sub-systems as studied in the various units covered in the course. The system should be interfaced with a digital controller with appropriate interface circuitry and original programming. Multiple platforms are to be considered such as microcontrollers, microprocessors and programmable logic controllers.

The proposed system by the learner should be documented through an appropriately written report following the template provided. A brief technical presentation and demonstration should be given to validate the proposed system.

Learning Outcomes

On completion of this unit the learner will be able to

1. *Compare system and sub-system components through research.*
2. *Perform a design, assembly and testing for an electronic and electrical system/s.*
3. *Perform a design and/or assembly for a mechanical system/s.*
4. *Program and interface a digital controller for use with electronic sensors and actuators.*
5. *Perform testing and inspection of the project system and sub-systems.*
6. *Document the performance of the project in the form of a report and presentation.*

CDKSE-406-1901: Mathematics for Electrical Engineering

Unit Level (MQF/EQF): 4
Credits: 6
Delivery Mode: Face-to-Face Learning
Total Learning Hours: 150

Unit Description

This unit provides a framework for students to develop mathematical thinking skills further to the level 3 unit specification to solve problems related to real-life situations. Students also develop skills, attributes and knowledge that contribute to their personal growth and effectiveness within their training and work environment and also within the community.

The unit is designed to adapt for the needs of a particular field of study (business & finance or engineering & transport and others).

To reach this goal the unit was divided into four learning outcomes which are related to statistics, graphical representation, geometry, trigonometry, algebra and finance. Through these different areas students will be able to develop the effective skills for information processing, reasoning, evaluation creative thinking and enquiry, all fundamental skills for the problem solving process. This will prepare students in applying and evaluating a range of strategies to solve real-life problems. Through this unit the learner will also learn to present and communicate results and conclusions effectively.

On successful completion of the unit the learner will be equipped with mathematical thinking skills which make them aware of and understand their thought process, to reassess and identify areas for development. Students learn to evaluate, reflect about their strategies, understand and verify results to solve problems. These skills will equip students with managerial skills, to further their studies and for work employability.

Learning Outcomes

On completion of this unit the student will be able to

1. *Demonstrate visual and logical techniques in evaluating graphical representations and communication skills in presenting the results effectively.*
2. *Apply information processing skills to solve problems in a relevant statistical context.*
3. *Demonstrate evaluation and communication skills in solving and presenting problems applied to costing methods and techniques.*
4. *Apply thinking skills in geometric, trigonometric and algebraic areas related to electrical engineering contexts.*

CDKSK-406-2001: English

Unit Level (MQF/EQF): 4
Credits: 6
Delivery Mode: Face-to-Face Learning
Total Learning Hours: 150

Unit Description

The main objective of this unit is to prepare students to use the English language to understand, analyse, organise and communicate specific technical knowledge by inferring meaning from, and using, embedded information, being able to evaluate information critically and communicate through different types of texts, as required by various but often specific technical contexts within the selected field of study.

The emphasis is on the processes needed to transition from use of the English language in General Education to that required for access to Higher Education.

In particular, L4 Key Skills English is targeted at learners who have completed Foundation College programmes (Levels 1 to 3) and seek to further their studies at Technical or Degree level.

In this respect, this unit recognises the necessity to meet two linguistic demands at this threshold level; strengthening students' linguistic competences to be able to communicate more specifically within their vocational area and stream and to prepare them for more rigorous academic thinking, research and writing as necessitated by degree courses.

Being introduced at this level are core and elective unit outcomes. Reading and writing outcomes are core components in this syllabus while listening and speaking are elective components. Every L4 programme must deliver the two core outcomes and any one of the two elective learning outcomes. The elective criteria to be assessed cannot be selected from and across both outcomes.

Learning Outcomes

On completion of this unit the student will be able to

1. *Read technical texts effectively to improve knowledge of the subject area.*
2. *Understand information presented orally in the form of recordings, or talks, discussions, seminars, interviews or presentations.*
3. *Demonstrate own understanding of the subject matter via oral presentation, mock interviews or similar oral delivery.*
4. *Write a research paper or technical report demonstrating cohesion, structure and appropriate style.*

CDKSK-406-2014: IT for Robotics

Unit Level (MQF/EQF): 4
Credits: 6
Delivery Mode: Face-to-Face Learning
Total Learning Hours: 150

Unit Description

This unit provides learners with instruction in networking technologies and their implementation. Topics include the OSI reference model, network protocols, transmission media, and networking hardware and software. The purpose of the course is to prepare the student to follow and analyse already made LANs and WANs and also to design basic networks using multiple routers.

Once the underpinning knowledge is covered the problems of remote sensors are introduced and an introduction to IoT technology is delivered. Several IoT ready boards will be discussed with their merits and demerits.

In the final part of this unit the student will be instructed on how to develop mobile applications using a high-level language, specifically the MIT App Inventor Online IDE. The learners would be able to develop mobile apps that can harness the sensors in the mobiles while being able to communicate over a range of network protocols and as a final task the learner would be interfacing the mobile app with a robotic system of his choice.

Learning Outcomes

On completion of this unit the student will be able to

1. *Understand TCP/IP, network layers and identify respective hardware.*
2. *Develop mobile applications for IoT and communication applications.*
3. *Develop mobile applications with graphical user interface that harness the mobile internal sensors.*
4. *Develop an App to remotely control a robot/robotic arm of his/her choice.*

CDKSK-404-1915: Employability and Entrepreneurial Skills

Unit Level (MQF/EQF): 4
Credits: 4
Delivery Mode: Face-to-Face Learning
Total Learning Hours: 100

Unit Description

This unit complements the vocational and key skill units at Level 4 and provides an opportunity for learners to enhance their employability and entrepreneurial skills.

Quite often, learners tend to focus most on technical skills and competences required in a certain trade which enable them to access employment. On the other hand, employers expect employees to be appropriately skilled to follow instructions, take initiative, work effectively in a team, take a lead when necessary and more. In view of this the unit starts with an introduction to the 4th industrial revolution and proceeds to the transversal skills necessary to find employment, retain employment and advance at the place of work. Learners will be able to highlight their strengths and identify the areas that require improvement.

The rest of the unit focuses on entrepreneurial skills, a skill which is one of the most important transversal skills identified by UNESCO. Learners are introduced to methods which can be used to generate new and innovative business ideas and methods which help them evaluate ideas and choose the most feasible. Furthermore, learners will cover the various stages of product and/or service development, including market analysis, processes, pricing strategy, promotion and resources required.

Learners will work in a small team and by the end of the unit they will have the opportunity to develop a business idea which is commercially viable. Furthermore, they will present the idea to prospective investors/stakeholders.

Learning Outcomes

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

1. *Understand the employability skills required for Industry 4.0.*
2. *Use idea generation techniques to come up with ideas and evaluate chosen ideas.*
3. *Understand the various stages of product and/or service development.*
4. *Work in a team to develop a business idea which is commercially viable.*

CDKSK-402-2104: Community Social Responsibility

Unit Level (MQF/EQF): 4
Credits: 2
Delivery Mode: Face-to-Face Learning
Total Learning Hours: 50

Unit Description

This unit focuses on Community Social Responsibility and provides an opportunity for learners to better understand themselves and the others and to establish goals in life. Community social responsibility enables learners to understand their strengths and areas for improvement and prepares them for life, employment and to become active citizens in society.

Moving away from traditional delivery of other units, learners will be empowered to take ownership of their learning process. Hence, community social responsibility will be delivered through a combination of workshops, small-group sessions with mentors and various opportunities to reflect.

The set of sessions will tackle community social responsibility skills and will mostly focus on the self, the ability to work independently and important values in life. The second set of sessions will address interpersonal skills and will focus on working with others, dealing with diversity and conflicts. Furthermore, at the end of the sessions, the learners will be introduced to the importance of active citizenship in life.

Learning Outcomes

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

1. *Identify personal goals through self-reflection.*
2. *Evaluate how collaboration with others can be more effective.*
3. *Explain the importance of giving and receiving feedback.*
4. *Contribute actively to make a difference in society.*