Malta College of Arts, Science & Technology

MQF Level 4

ME4-A3-19

Advanced Diploma in Polymer Process Technicians

Course Specification

Course Description

This Advanced Diploma programme is designed to prepare technicians for a career in the field of the transformation of rubbers and plastics, with their different types and compositions, into finished specialised products. It provides a good level of knowledge in the fields of polymer sciences and manufacturing technologies. The scientific background of the technologies and processes involved, including material properties, process control and the effect of variables such as temperature, pressure, and cycle time, are also studied.

Training is achieved through a combination of theory and practical sessions of this latest technology in the lecture rooms and workshops, as well as at local industry leaders of this ever-growing sector of manufacturing.

Applicants have to be able to work within the industries concerned.

Programme Learning Outcomes

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

1. *Understand the science of plastic/rubber transformations;*
2. *Apply engineering knowledge in resolving problems encountered during manufacturing;*
3. *Maintain and improve machinery involved in the processes to optimise their performance;*
4. *Understand the operations and failure modes of the large variety of specialised equipment.*

Entry Requirements

MCAST Diploma in Mechanical Engineering

or

MCAST Diploma in Engineering (Electronics)

or

MCAST Diploma in Aircraft Maintenance

or

4 SEC/O-Level/SSC&P (Level 3) passes

Compulsory: One subject from Mathematics or Physics and One subject from Engineering Technology, Design and Technology, Chemistry, Mathematics, Physics

Current Approved Programme Structure

Unit Title	ECVET
Business Operations in Engineering	6
Communications for Engineering Technicians	6
Computer Aided Drafting in Engineering	6
Electrical and Electronic Principles	6
Engineering Drawing for Technicians	6
Engineering Maintenance Procedures and Techniques	6
Engineering Primary Forming Process	6
Engineering Project	12
Further Mathematics for Technicians	6
Health and Safety in the Engineering Workplace	6
Industrial Process Controllers	6
Manufacturing Processes	6
Mathematics for Engineering Technicians	6
Mechanical Principles	6
Mould Materials	6
Polymer Process Engineering	6
Polymer Science	6
Properties and Applications of Engineering Material	6
Rubber Technology	6
Total ECVET	**120**

Unit: Business Operations in Engineering

Unit level (MQF): 4
Credits : 6

Unit Description

This unit gives learners an understanding of the major factors that affect the way that engineering companies operate in competitive business environments. They will also develop skills in costing techniques for engineering activities.

Engineers are employed in a range of businesses within the primary, secondary and tertiary sectors. Their knowledge and skills are used to carry out a variety of specific functions that solve the needs of businesses and contribute to their commercial success. By making effective use of their engineers' expertise, organisations can secure competitive advantage, whether they are a small owner-managed company or a large limited company with many shareholders.

For anyone considering a career in engineering, it is important to have an understanding of how an engineering business operates and its position within society. This unit will develop learners' understanding of business, the engineering industry and the effect of engineering or the environment. It will help give learners a firm foundation for employment in the engineering sector and an understanding of the organisational, financial, legal, social and environmental constraints within which an engineering company operates.

The unit will enable learners to examine an engineering company in detail. This could be either the one in which they are employed or one in an engineering sector in which they may look for employment. Learners will understand how the company operates, the factors that impact upon the business and the importance of a cost-effective output. This will include an examination of the engineering functions of the company and the importance of communication and information flow within the business. This is set within a study of how external factors and the economic environment impact on the company.

Learners will examine relevant legislation and how it can place considerable constraints on the way that a typical engineering company is required to operate. A

company cannot survive if it is not profitable and the unit allows learners to consider the use and implication of costing techniques on the sustainability of a particular engineering activity.

Learning Outcomes

On completion of this unit the learner will be able to

1. *Understand how an engineering company operates*
2. *Understand how external factors and the economic environment can affect the operation of an engineering company*
3. *Know how legislation, regulation and other constraints impact on the operation of engineering businesses*
4. *Apply costing techniques to determine the cost effectiveness of an engineering activity*

Unit: Communications for Engineering Technicians

Unit level (MQF): 4
Credits : 6

Unit Description

The ability to communicate effectively is an essential skill in all aspects of life. The usual methods of communication – speaking, reading and writing – receive considerable attention and learning time during all stages of education. For engineers, these skills are of no less importance, but there are further complications with the need to also convey technical information such as scale, perspective and standards of working.

The drive towards greater use of information and communication technology (ICT) is also very much a part of modern life and this again is certainly the case for engineering. The engineering industry is in the front line of working towards paperless communication methods, for example the electronic transfer of data from the concept designer straight to the point of manufacture.

This unit will provide a foundation for employment in a wide range of engineering disciplines (for example manufacturing, maintenance, communications technology) in addition to providing a foundation for further study. It aims to develop learner's ability to communicate using a diverse range of methods. These include visual methods, such as drawing and sketching, and computer-based methods, such as two-dimensional (2D) computer aided drawing (CAD) and graphical illustration packages it will also develop learners' ability to write and speak within a framework of technology-based activities using relevant and accurate technical language appropriate to the task and the audience.

The unit will also introduce learners to a variety of skills and techniques to obtain and use information, for example the presentation of technical reports, business and technical data and the use of visual aids for presentations. Learners will also consider how to make best use of ICT within technological settings that are relevant to their programme of study or area of employment.

Learning Outcomes

On completion of this unit the learner will be able to

1. *Interpret and use engineering sketches/circuit/network diagrams to communicate technical information*
2. *Use verbal and written communication skills in engineering settings*
3. *Obtain and use engineering information*
4. *Use information and communication technology (CT) to present information in engineering settings.*

Unit: Computer Aided Drafting in Engineering

Unit level (MQF): 4
Credits : 6

Unit Description

This unit gives learners the knowledge and skills needed to use computer aided drafting (CAD) techniques in an engineering context.

Computer aided drafting is fast becoming the primary means of communicating design information in many industry sectors, particularly in engineering and manufacturing. Two-dimensional (2D) CAD drawings and three-dimensional (3D) CAD data can be shared with computer numerical control (CNC) machines using computer aided manufacturing (CAM) software. 3D models can be rendered to produce photo-realistic representations, or can be animated to produce moving views of products and components as they would appear in service. Additionally, models can be used to analyse features such as mass, volume and mechanical properties.

This unit will enable learners to produce a variety of CAD drawings, from single-part 2D components to complex 3D models. Advanced techniques, such as using pre-prepared symbols to construct circuit diagrams and assembly drawings, will provide opportunities for learners to develop their skills. Learners will also investigate the use of CAD in industry, the hardware and software required and the links with other software packages. In doing this learners will appreciate the advantages of CAD over more conventional methods of drawing production.

Finally, learners will generate 3D models, make comparison with 2D CAD drawings and evaluate the impact of this technology on manufacturing companies and their customers.

The unit as a whole provides an opportunity to carry out practical CAD activities using a full range of commands and drawing environments. In addition, learners will gain an understanding of the use and impact of CAD on the manufacturing industry.

Learning Outcomes

On completion of this unit the learner will be able to

1. *Know the advantages of using CAD in comparison with other methods*
2. *Know about the software and hardware required to produce CAD drawings*
3. *Produce and interpret CAD drawings*
4. *Use CAD software to produce 3D drawings and views.*

Unit: Electrical and Electronic Principles

Unit level (MQF): 4
Credits : 6

Unit Description

The modern world relies on electrical and electronic devices — from mobile telephones to jet aeroplanes, these devices have had an enormous impact on the way we live today. Without early engineers such as Faraday and Lenz, who studied the then new concept of electricity, many of the inventions we now take for granted would not have been developed.

The unit starts by developing and extending learners' understanding of fundamental electrical and electronic principles through analysis of simple direct current (DC) circuits. Learners are then taken through the various properties and parameters associated with capacitance and inductance, before finally considering the application of single-phase alternating current (AC) theory. The unit will encourage learners to take an investigative approach through practical construction, measurement and testing of circuits and, where applicable, the use of computer-based circuit analysis and simulation.

For learners wishing to follow an electrical/electronic programme this unit is an essential building block that will provide the underpinning knowledge required for further study of electrical and electronic applications.

Learning Outcomes

On completion of this unit the learner will be able to

1. *Use circuit theory to determine voltage, current and resistance in direct current (DC) circuits*
2. *Understand the concepts of capacitance and determine capacitance values in DC circuits*
3. *Know the principles and properties of magnetism*
4. *Use single-phase alternating current (AC) theory.*

Unit: Engineering Drawing for Technicians

Unit level (MQF): 4
Credits : 6

Unit Description

This unit will enable learners to produce engineering drawings of different components, assemblies and circuits using a variety of sketching, drawing and computer-aided drafting techniques.

It is important that when a product has been designed it is manufactured correctly and to specification. To achieve this it is crucial that the people making the product in a workshop are provided with well-presented engineering drawings, produced to international standards and conventions. This avoids errors of interpretation which can lead to the scrapping of expensive parts.

An understanding of how graphical methods can be used to communicate information about engineering products is an important step for anyone thinking of taking up a career in engineering. This unit gives learners an introduction to the principles of technical drawings and their applications using hand drawing and computer-aided drafting (CAD) techniques.

Learners will start by carrying out freehand sketching of simple engineering products using pictorial methods that generate three-dimensional images. A range of standard components, such as fixing devices, will be sketched together with other solid and hollow items. Learners are then introduced to a more formalised drawing technique that conforms to British Standards and will put this into practice through a number of drawing exercises. A consistent presentation style will be used as learners draw single part components and simple engineering assemblies.

These drawings will contain all the information needed to manufacture or assemble the product, including information such as dimensions, manufacturing notes and parts lists. The use of conventions to represent standard items will be investigated, such as screw threads and springs in mechanical type drawings or circuit symbols such as solenoids and resistors in electrical/electronic type drawings.

Having learned the principles of engineering drawing, learners will then move on to using a two-dimensional (2D) CAD system for the production of drawings using basic set-up, drawing and editing commands. The first task is to produce a drawing template which can be saved to file, as this reinforces the concept of standardisation and consistency of presentation. This is followed by drawing exercises of single-part components, a simple multi-part assembly and circuit diagrams.

Overall, the unit will develop learners' ability to create technical drawings and allow them to compare the use of manual and computer aided methods of producing engineering drawings.

Learning Outcomes

On completion of this unit the learner will be able to

1. *Sketch engineering components*
2. *Interpret engineering drawings that comply with drawing standards*
3. *Produce engineering drawings*
4. *Produce engineering drawings using a computer aided drafting (CAD) system*

Unit: Engineering Maintenance Procedures and Techniques

Unit level (MQF): 4
Credits : 6

Unit Description

The correct maintenance of engineering systems results in improved efficiency and can save organisations time and money in relation to system downtime and stoppages in production. This unit introduces learners to a range of commonly used engineering maintenance procedures and monitoring techniques, which may be encountered in any manufacturing, plant or process environment. The unit will also help learners understand how the data gathered from monitoring engineering systems can be used.

Learners will examine the consequences of maintenance and maintenance planning in terms of cost, and the implications for production, personnel, the environment and safety. They will gain an understanding of engineering maintenance and process planning and develop the skills needed to plan scheduled and preventative maintenance activities on engineering systems.

The unit has been designed to reflect the multidisciplinary nature of maintaining manufacturing plant and process engineering systems, rather than being confined to specialist knowledge of a single discipline. Learners will need to produce a maintenance plan for an engineering system involving two or more interactive technologies from mechanical, electrical, fluid power, process control or environmental systems.

Learners will be required to know about the methods, procedures and documentation that must be completed before handing over maintained systems, and how to confirm that the system is ready to run in a safe and operable condition.

Finally, learners will gain an understanding of the basic techniques of condition monitoring and how computerised maintenance systems can be used to capture data and predict specific failure trends in plant, machinery, equipment and systems.

Learning Outcomes

On completion of this unit the learner will be able to

1. *Know about the types of maintenance associated with engineering plant, equipment and systems*
2. *Know about maintenance frequency, the cost of maintenance and its effects on production*
3. *Produce a maintenance plan for a specific engineering system*
4. *Understand how data gathered from monitoring the performance and condition of engineering plant, equipment and systems can be used.*

Unit: Engineering Primary Forming Process

Unit level (MQF): 4
Credits : 6

Unit Description

This unit gives learners the opportunity to explore some of the primary forming processes found in engineering that are used to make a range of different components.

Almost everything we touch in the world of technology has been created through some technique or process associated with primary forming – the forming of shapes with minimal waste and loss of volume. Without these primary forming processes, the technological world as we know it today would not exist.

Many engineering components are initially formed by moulding, deformation or shaping. Over the years, these processes have been refined to suit the introduction of new materials and the demands of quantity production. In some processes, the shaped component is almost ready for use and requires only a little cleaning and trimming. In others it is produced slightly oversize and, after cleaning and trimming, it is machined accurately to the required dimensions.

The main aim of this unit is to provide a broad understanding of manufacturing processes associated with primary forming. It will give learners a broad understanding of moulding techniques for metals, ceramics and polymers, deformation processes for metals and polymers, and shaping and assembly of composites.

The unit will introduce learners to a range of techniques and primary processes but will provide a deeper understanding of the more common processes.

For each technique and process learners will form an appreciation of the fundamental process requirements, the working techniques used and the relevant health and safety considerations. The use of these primary processes sometimes creates a dangerous environment and knowledge of relevant health and safety and related legislation is very important.

Learning Outcomes

On completion of this unit the learner will be able to

1. *Know how moulding techniques involving metals, ceramics and polymers are used*
2. *Know how deformation processes involving metals and polymers are used*
3. *Know how shaping and assembly processes involving composites are used*
4. *Understand how health and safety issues relate to primary forming processes.*

Unit: Engineering Project

Unit level (MQF): 4
Credits : 12

Unit Description

This unit aims to enable learners to specify, plan and implement an engineering project and present its outcome. In the modern world engineers and technicians are often involved fully or in part with identifying problems and finding suitable solutions. These engineering problems may range from a very large project, such as designing and building a hydroelectric power station, to smaller projects, such as designing and producing a paper clip to keep notes secure. No matter how large or small, these problems need to be project managed in order to find engineered solutions. This unit will provide learners with opportunities to present their own solutions to engineering projects and should enable them to feel confident in carrying out project work within their chosen engineering discipline at the technician level.

The unit aims to integrate the knowledge and skills learners have gained throughout their programme of study, into a major piece of work that reflects the type of performance expected of an engineering technician. The project is intended to develop the learner's ability to identify and plan a course of action and follow this through to produce a viable solution/outcome to an agreed specification and timescale.

The end result of the project could be an engineering product, device, service or process or a modification to an existing process or product. As in the real world, the outcome of the project and its presentation are very important, although this project is also about developing the process skills necessary to carry out the project. Throughout the project learners will need to apply the technical skills developed in the other units in the qualification.

Learning Outcomes

On completion of this unit the learner will be able to

1. *Specify a project, agree procedures and choose a solution*
2. *Plan and monitor a project*
3. *Implement the project plan within agreed procedures*
4. *Present the project outcome.*

Unit: Further Mathematics for Technicians

Unit level (MQF): 4
Credits : 6

Unit Description

This unit aims to enhance learners' knowledge of the mathematical principles used in engineering, enabling them to pursue further study on a higher education qualification in engineering.

Mathematics is an essential tool for any electrical or mechanical engineering technician. With this in mind, this unit emphasises the engineering application of mathematics. For example, learners could use an integral calculus method to obtain the root mean square (RMS) value of a sine wave over a half cycle.

The first learning outcome will extend learners' knowledge of graph plotting and will develop the technique of using a graph to solve (find the roots of), for example, a quadratic equation.

Learning outcome 2 involves the use of both arithmetic and geometric progressions for the solution of practical problems. The concept of complex numbers, an essential tool for electrical engineers considering, is also introduced.

Learning outcome 3 considers the parameters of trigonometrical graphs and the resultant wave when two are combined. The use of mathematical formulae in the latter half of this learning outcome enables a mathematical approach to wave combination to be considered.

Finally, in learning outcome 4, calculus techniques are further developed and used to show their application in engineering.

Learning Outcomes

On completion of this unit the learner will be able to

1. *Use advanced graphical techniques*
2. *Apply algebraic techniques*
3. *Manipulate trigonometric expressions and apply trigonometric techniques*
4. *Apply calculus.*

Unit: Health and Safety in the Engineering Workplace

Unit level (MQF): 4
Credits : 6

Unit Description

This unit will give learners an understanding of the key features of health and safety legislation and regulations and how these are applied in engineering to ensure safe working conditions.

The welfare of people working or operating within any manufacturing or engineering environment is of prime importance. All workers should expect to be able to carry out their work in a safe manner that has no negative effect on their health and wellbeing. In fact, many organisations not only reduce risks and make improvements to the working environment but try to make their own working environment superior to others, making it a competitive aspect when recruiting staff.

Health and safety in the workplace is about measures designed to protect the health and safety of employees, visitors and the general public who may be affected by workplace activities. Safety measures are concerned with controlling and reducing risks to anyone who might be affected by these activities.

Health and safety is controlled largely by legislation and regulations and the law is continually being revised and updated. It is important that organisations are aware of these changes and keep up to date with developments.

This unit will give learners an understanding of hazards and risks associated with health, safety and welfare in an engineering workplace, the associated legislation and regulations and of their roles in complying with the related legal obligations. Learners will also be required to undertake full risk assessments and to appreciate the significant risks encountered in the workplace and the measures taken to deal with them. They will also study the principles of reporting and recording accidents and incidents, again within a legal context.

This unit could form a key component within many learning programmes since the content is highly applicable to many manufacturing, engineering and industrial situations.

Learning Outcomes

On completion of this unit the learner will be able to

1. *Understand the key features of health and safety legislation and regulations*
2. *Know how to identify and control hazards in the workplace*
3. *Carry out a risk assessment, identifying control measures*
4. *Understand the methods used when reporting and recording accidents and incidents.*

Unit: Industrial Process Controllers

Unit level (MQF): 4
Credits : 6

Unit Description

This unit provides learners with an opportunity to gain knowledge and experience of the industrial process controllers that are the main elements within a controlled system. Control engineering plays an important role in ensuring that process plant and machine controlled systems function correctly and with optimum performance. This unit provides learners with an opportunity to gain knowledge and experience of the industrial process controllers that are the main elements within a controlled system.

The unit starts with basic control and the comparison of common control technologies and applications. It then proceeds to examine the traditional three-term controllers that are still widely used in industry and the principles required to tune and set up these controllers.

The unit then develops the knowledge and practical skills that are essential to configure and program a programmable logic controller (PLC). Various instruction types are described and learners will be required to write programs to perform a range of control applications. Learners will also gain a knowledge of faultfinding techniques and tools and will be able to write and fault-find programmable logic controllers.

This unit could form a key component within many learning programmes since the content is highly applicable to many manufacturing, engineering and industrial situations.

Learning Outcomes

On completion of this unit the learner will be able to

1. *Know about control system types and their applications*
2. *Know about the operating principles and tuning of three-term controllers*
3. *Know about the types and operation of programmable logic controllers*
4. *Write and fault-find programmable logic controller programs.*

Unit: Manufacturing Processes

Unit level (MQF): 4
Credits : 6

Unit Description

This unit builds on the basic concepts of plastics technology and provides an opportunity to develop knowledge of plastics processing methods. Learners will develop an understanding of plastics processing techniques for thermoplastic and thermoset materials. Learners will be given every opportunity to develop their understanding through practical investigation.

This unit presents opportunities to gather evidence towards level 3 key skills: communication and working with others. This unit provides underpinning knowledge for the NVQs in Polymer Processing and Related Operations at level 3.

The unit also provides opportunities for the wider curriculum.

Learning Outcomes

On completion of this unit the learner will be able to

1. *Describe and explain the moulding techniques used for manufacture of plastic products*
2. *Investigate and describe the features of plastics extruders and extrusion processes*
3. *Investigate and describe the manufacture of film and sheet materials and conversion to products*
4. *Describe and explain the techniques used in the manufacture of products from phenolic, epoxy and polyester laminates.*

Unit: Mathematics for Engineering Technicians

Unit level (MQF): 4
Credits : 6

Unit Description

This unit aims to give learners a strong foundation in mathematical skills. These skills will help them to successfully complete many of the other units within the qualification.

One of the main responsibilities of engineers is to solve problems quickly and effective1y, This unit will enable learners to solve mathematical, scientific and associated engineering problems at technician level. It will also act as a basis for progression to study other units both within the qualification, such as the unit Further Mathematics for Technicians, and at Higher National level.

This unit enables learners to build on knowledge gained at GCSE or First Diploma level and use it in a more practical context for their chosen discipline. Learning outcome I will develop learners' knowledge and understanding of algebraic methods, from a look at the use of indices in engineering to the use or-the algebraic formula for solving quadratic equations. Learning outcome 2 involves the introduction of the radian as another method of angle measurement, the shape of the trigonometric ratios and the use of standard formulae to solve surface areas and volumes of regular solids. Learning outcome 3 requires learners to be al* to represent statistical data in a variety of ways and calculate the mean, median and mode, Finally, learning outcome 4 is intended as a basic introduction to the arithmetic of elementary calculus.

Learning Outcomes

On completion of this unit the learner will be able to

1. *use algebraic methods*
2. *use trigonometric methods and standard formula to determine areas*
3. *use statistical methods to display data*
4. *use elementary calculus techniques.*

Unit: Mechanical Principles

Unit level (MQF): 4
Credits : 6

Unit Description

This unit gives learners the opportunity to extend their knowledge of mechanical principles and to apply them when solving engineering problems. The use and application of mechanical systems is an essential part of modern life. The design, manufacture and maintenance of these systems are the concern of engineers and technicians who must be able to apply a blend of practical and theoretical knowledge to ensure that systems work safely and efficiently. Science underpins all aspects of engineering and a sound understanding of its principles is essential for anyone seeking to become an engineer.

The selection and use of engineering materials builds on the principles laid down by the scientists Hooke and Young. The laws of motion, put forward by Sir Isaac Newton, underpin the design of dynamic engineering systems ranging from domestic appliances through motor vehicles to spacecraft. Similarly, the design of internal combustion engines and gas turbines is based on the principles and laws that were put forward by Boyle, Charles and Joule.

This unit aims to build upon the knowledge gained at GCSE and First Diploma level. Learning outcome 1 will introduce learners to the behaviour of loaded engineering materials and the analysis of a range of static engineering systems that will include the application of Hooke's Law and Young's modulus.

Learning outcome 2 will extend learners' knowledge of dynamic systems through the application of Newtonian mechanics. It will also consider the storage and transfer of energy that is often involved in the operation of mechanical systems. Learning outcomes 3 and 4 seek to lay the foundation for future work in applied thermodynamics and fluid mechanics. In particular, they will deal with the effects of heat transfer, the expansion and compression of gases and the characteristic behaviour of liquids at rest and in motion.

This unit provides a basis for further work in the areas of mechanical principles, engineering thermodynamics, fluid mechanics and other related applications of engineering science.

Learning Outcomes

On completion of this unit the learner will be able to

1. *On completion of this unit the student will be able to*
2. *Determine the effects of loading in static engineering systems*
3. *Determine work, power and energy transfer in dynamic engineering systems*
4. *Determine the parameters of fluid systems*
5. *Determine the effects of energy transfer in thermodynamic systems.*

Unit: Mould Materials

Unit level (MQF): 4
Credits : 6

Unit Description

This unit is intended for pupils working in the polymer industry with the intent of progressing in their career. Students will be introduced to steel and its alloying. Different classes of steel and its alloys will be covered as well as the major constituents within the material's microstructure, namely, ferrite, martensite, pearlite, bainite and martensite. In addition, learners will gain knowledge on the treatment of such materials to improve properties such as strength, toughness, hardness and wear resistance. This will also be done for high strength beryllium-copper alloys which also find use as mould materials.

Learning Outcomes

On completion of this unit the learner will be able to

1. *Know the constituents of steel and the respective properties of each as well as a good insight into the roles of individual alloying elements.*
2. *Identify the various classes of steel that may be used in the production of moulds.*
3. *Explain the wide range of treatments that can be applied to steel to modify or enhance several properties.*
4. *Know the wide range of advanced treatments that can be applied to steel to modify or enhance the material's properties.*

Unit: Polymer Process Engineering

Unit level (MQF): 4
Credits : 6

Unit Description

The unit addresses the process engineering principles used in the polymer industry. It includes the principles of drive systems, hydraulics, temperature measurement and control, and robotics. The learner will gain knowledge of the systems used in modern polymer processing plants such as injection moulding machines, extruders, presses and mills. This unit presents opportunities to gather evidence towards the following key skills at this level application of number, communication and working with others This unit provides underpinning knowledge. Polymer Processing and Related Operations at this level.

Learning Outcomes

On completion of this unit the learner will be able to

1. *Explore and report the principles of mechanical drive systems including belt, gear and chain drives*
2. *Investigate and describe the construction and operation of hydraulic systems*
3. *Investigate and describe heating systems, and temperature measurement and control used on polymer processing equipment*
4. *Investigate and describe the different types and applications of industrials robots*

Unit: Polymer Science

Unit level (MQF): 4
Credits : 6

Unit Description

This unit introduces learners to the basic concepts of polymer science and provides opportunities to develop an understanding of the basis of polymer characteristics outlined in the Units Rubber Technology and Plastic Products and Specialist Elastomers.

Learners will develop knowledge of polymerization mechanisms and processes, glass transition temperature, crystallization, molecular size and structure. Learners should be given the opportunity to develop their understanding through practical investigation.

This unit presents opportunities to gather evidence towards the following key skills at this level application of number, communication, information technology and working with others.

Learning Outcomes

On completion of this unit the learner will be able to

1. *Investigate polymerisation reactions and describe specific examples illustrating the nature of polymerisation*
2. *Investigate glass-rubber transition and describe the structural features which influence the glass transition temperature of polymers*
3. *Describe polymer crystallinity and relate the structural features that influence the ability of a polymer to crystallise*
4. *Relate the effects of molecular size and structure to polymer performance*

Unit: Properties and Applications of Engineering Material

Unit level (MQF): 4
Credits : 6

Unit Description

In-depth knowledge of the structure and behaviour of engineering materials is vital for anyone who is expected to select or specify them for applications within the engineering industry. This unit will give learners an understanding of the structures, classifications and properties of materials used in engineering and will enable them to select materials for different applications.

The unit is appropriate for learners engaged in manufacturing and mechanical engineering, particularly where materials are sourced in the form of stock to be used in a production process. The unit covers a range of materials, some of which learners may not be familiar with initially.

This unit will enable learners to identify and describe the structures of metals, polymers, ceramics and composites and classify them according to their properties. Learners will also be able to describe the effects of processing on the behaviour of given materials. Smart materials whose properties can be altered in a controlled fashion through external changes – such as temperature and electric and magnetic fields – are also covered.

Learners will apply their understanding of the physical and mechanical properties of materials, design requirements, cost and availability to specify materials for given applications.

All materials have limits beyond which they will fail to meet the demands placed on them. The common modes of failure will be both demonstrated and described to enable learners to recognise where an informed choice can make the difference between the success or failure of a product.

Learning Outcomes

On completion of this unit the learner will be able to

1. *Know the structure and classification of engineering materials*
2. *Know material properties and the effects of processing on the structure and behaviour of engineering materials*
3. *Use information sources to select materials for engineering uses*
4. *Know about the modes of failure of engineering materials.*

Unit: Rubber Technology

Unit level (MQF): 4
Credits : 6

Unit Description

This unit builds on the basic concepts of rubber technology and provides an opportunity to develop an understanding of high consumption rubbers and processing methods. Learners will develop an understanding of mix additives, mix design, processing, vulcanisate properties and applications of the high tonnage rubbers. Learners will be given every opportunity to develop their understanding through practical investigation.

This unit presents opportunities to gather evidence towards the level 3 key skills: application of number, communication and working with others. This unit provides underpinning knowledge for the NVQs in Polymer Processing and Related Operations at level 3. This unit provides opportunities for the wider curriculum.

Learning Outcomes

On completion of this unit the learner will be able to

1. *Identify and describe the effects of additives used in rubber mix design*
2. *Describe the classification, properties and applications of rubbers*
3. *Investigate the use of additives in the mix design in the processing, costs and property modification of rubbers*
4. *Discuss the construction and use of processing equipment for the manufacture of rubber products.*