MQF Level 6

AS6-01-21

Bachelor of Science (Honours) in Chemical Technology

Course Specification

Course Description

This degree is geared towards those students who envisage a career in applied chemical sciences and related industries. The programme will offer an opportunity for students to gain a foundation in the core chemistry concepts and the manufacture of chemical products, such as pharmaceuticals, polymers, foods, beverages and petrochemicals. The knowledge, skills and competences attained give the individuals an opportunity to succeed in employment in a wide range of manufacturing and processing industries, consulting firms, government, research and educational institutions.

The course will expose students to the development and design of chemical processes at different scales and creates a bridge between science and manufacturing, by applying the principles of chemistry and engineering to solve problems involving the production or use of chemicals. The programme also provides opportunities for learners to focus on the development of higher level skills in a scientific and technological context, providing learners to develop a range of skills and attributes essential for successful performance in professional working life.

Within this degree students will be required to choose one minor stream of 5 units (amounting to 30 ECTS) from the following 4 options: Chemical Engineering; Human Sciences; Computer Engineering; Organizational Decision Making.

Programme Learning Outcomes

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

1. *Understand theoretical aspects of fundamental and specialized chemistry subjects and apply the acquired knowledge to solve complex problems encountered in the chemical industry.*
2. *Understand the processes involved in the research and development of chemical manufacturing activities.*
3. *Understand the operation and maintenance of industrial chemical plants and appreciate the need of health and safety and environmental considerations.*
4. *Know how to manage a quality system and understand the typical duties of laboratory managers in different types of laboratory.*

Entry Requirements

MCAST Advanced Diploma in Applied Science
or
2 A-Level Passes and 2 I-Level Passes
Compulsory A-Level: Chemistry
Preferred A or I-Level: Biology or Physics or Mathematics (Pure or Applied)

Current Approved Programme Structure

Unit Code	Unit Title	ECVET/ECTS	Year
ASCHM-506-1504	Inorganic Chemistry	6	1
ASCHM-506-2101	Organic Chemistry	6	1
ASCHM-506-2107	Physical Chemistry	6	1
ASCHM-506-2000	Advanced Chemical Laboratory Techniques 1	6	1
ASASC-503-2000	Analysis of Scientific Data and Information 1	3	1
ASCHM-506-2102	Introduction to Chemical Engineering	6	1
ASENV-506-2101	Environmental Monitoring and Analysis	6	1
ASLAB-506-2101	Laboratory Management	6	1
ASPRJ-506-2008	Research methods within a research project 1	6	1
ASWBL-503-2007	Work Based Experience 1	3	1
CDKSK-503-1907	English 1	3	1
CDKSK-503-1905	Critical Thinking 1	3	1
ASCHM-506-2001	Advanced Chemical Laboratory Techniques 2	6	2
ASASC-503-2001	Analysis of Scientific Data and Information 2	3	2
ASCHM-506-1509	Principles of Spectroscopy and Chromatography	6	2
ASCHM-506-2108	Essential practical techniques	6	2
ASCHM-506-2105	Industrial Chemistry	6	2
ASCHM-506-1513	Medicinal Chemistry	6	2
ASCHM-506-1514	Quality Assurance and Quality Control	6	2
ASPRJ-506-2009	Research methods within a research project 2	6	2
ASWBL-503-2008	Work Based Experience 2	3	2
CDKSK-604-1909	Entrepreneurship	4	2
CDKSK-602-2105	Community Social Responsibility	2	2
CDKSK-503-1908	English 2	3	2
CDKSK-503-1906	Critical Thinking 2	3	2
ASCHM-606-2002	Analytical Chemistry	6	3
ASCHM-606-1515	Chemical Reaction Engineering	6	3
ASCHM-606-1516	Chemical Engineering Thermodynamics	6	3
ASENG-606-1518	Fundamentals of Engineering and Process Engineering	6	3
ASCHM-606-1517	Mechanical Operations	6	3
ASASC-606-1503	Process Modelling and Computing	6	3
ASCHM-606-1518	Separation Processes	6	3
ASCHM-606-1519	Transport Phenomena	6	3
ASDIS-612-1601	Dissertation	12	3
Total ECVET/ECTS		**180**	**/**

ASCHM-506-1504 Inorganic Chemistry

Unit level (MQF): 5

Credits: 6

Unit Description

The unit will allow the learner to obtain a sound foundation of inorganic chemistry. Inorganic chemistry is the study of the properties and behaviour of the elements and their compounds.

This unit provides the learner with the knowledge of the periodic classification of the elements in terms of the behaviour of the elements themselves and that of their compounds. It will give the learner knowledge about the periodic trends of the elements and will enable the learner to predict the properties of elements based on their position within the periodic table.

It also introduces the learner to the quantum mechanical model for the arrangement of electrons in the atoms. It also provides an inside depth into the bonding of atoms and molecular orbital theory. It will enable the learner to apply these models in order to predict the shape and properties of molecules and compounds.
This unit is relevant to learners wishing to further their knowledge of chemistry in order to have a sound theoretical basis for the understanding of the properties of compounds and material chemistry.

Learning Outcomes

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

1. *Use quantum mechanics to explain the electronic arrangement in atoms.*
2. *Apply the concepts of bonding to explain the properties of compounds.*
3. *Describe and explain the periodic classification of elements*
4. *Explain the properties of elements, and their compounds, in terms of their electronic configuration.*

ASCHM-506-2101 Organic Chemistry

Unit level (MQF): 5

Credits: 6

Unit Description

This is a knowledge and skills-based unit that will allow learners to demonstrate that they have a proper understanding of basic organic compounds: their basic chemical structure, their properties and reactions, and their reaction mechanisms.

By expanding on the knowledge attained from other chemistry units and by introducing new concepts related the field of organic chemistry, this unit is meant to serve as a sound introduction to organic chemistry. In particular, the unit delves further into the specific organic chemistry reaction mechanisms which have not been covered in other units. In essence, this unit will be developing the learners' knowledge of organic chemistry by reviewing basic and new material.

By placing an emphasis on the industrial importance of such reactions and processes, this information will allow the learners to further appreciate the wide variety of organic compounds and their use within society.

Based on theoretical and practical work, both as part of formal and summative assessment, learners will be able to complete coursework and examinations for this unit.

Learning Outcomes

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

1. *Describe the structure and bonding of organic compounds.*
2. *Recognise the terminology used in organic reaction mechanisms.*
3. *Evaluate the reactions of aromatic and non-aromatic hydrocarbons.*
4. *Analyse the reactions of mono-functional group compounds.*

ASCHM-506-2107 Physical Chemistry

Unit level (MQF): 5

Credits: 6

Unit Description

Unit will allow the learner to obtain a sound foundation of physical chemistry. It provides a concise coverage of a wide range of essential topics in physical chemistry and this will give the learner valuable insight into in the various processes that physical chemistry entails.

This unit is relevant to learners wishing to further their knowledge of chemistry in order to have a sound theoretical basis for laboratory analysis. It will enable the learner to understand the chemistry of gases and vapours together with key concepts of energetics, kinetics and equilibria. This unit involves several mathematical calculations and it is important that the learner has a proper basis of mathematics, especially algebra and solving equations.

The learner will make use of mathematical models to describe and predict physical phenomena such as enthalpies of reaction and rates of reactions. At the end of this unit, the learner will understand the driving force behind chemical reactions that take place around us.

Learning Outcomes

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

1. *Describe properties of gases and vapors together with the laws thermodynamics.*
2. *Apply the concepts of chemical energetics.*
3. *Apply the concepts of chemical kinetics.*
4. *Evaluate the concepts of chemical, ionic, redox equilibria.*

ASCHM-506-2000 Advanced Chemical Laboratory Techniques 1

Unit level (MQF): 5

Credits: 6

Unit Description

Advanced Chemical Laboratory Techniques is taught over two modules (1 and 2). This is the first module and covers the principles of chemical synthesis and spectroscopic techniques. This unit is designed to develop learners in a range of laboratory skills that extends from MQF/EQF Level 4 Chemical Laboratory Techniques. Learners will further synthesize organic and inorganic compounds using a range of techniques which are important in the new drug development. The products will be separated, identified and the purities are determined using spectroscopic techniques. Chromatographic techniques will be introduced in Advanced Chemical Laboratory Techniques 2. Thorough risk assessments will be carried out for all practical work and the results acquired will be analyzed and presented in the form of a scientific report.

In a world of increasing Health and Safety regulations, it has become mandatory for Science Laboratory workers to follow the most stringent procedures for handling normal and hazardous substances and dispose of them appropriately. Learners will gain autonomy to analyse experimental procedures, research hazards and risks involved using Material Safety Data Sheet (MSDS) and completing Control of Substance Hazardous to Health (COSHH) forms and risk assessments.

Learners will study the mechanism of a chemical reaction to understand the sequence of events that take place as reactant molecules are converted into products. This allows the simplification of complex chemical reactions into elementary processes.

Practical work should enhance learners' knowledge and understanding by following the predicted reaction pathways. Where an unexpected observation is made, learners will have the opportunity to evaluate the reasons for the cause of the failure. The products can be identified using spectroscopic methods following the synthesis for determining concentrations and purities. Learners will acquire presentation skills throughout this unit by writing laboratory reports using Scientific Journal format as well as making a presentation using PowerPoints and posters.

On completion of the unit, learners will gain competence in many aspects of synthetic and instrumental chemistry commonly used in the research laboratory environment.

Learning Outcomes

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

1. *Conduct risk assessments for the use of chemical reagents.*
2. *Synthesize organic and inorganic compounds using standard chemical techniques.*
3. *Determine the percentage yield of a chemical reaction and the purity of a synthesized compound.*
4. *Understand the fundamental principles of spectroscopic techniques.*
5. *Use spectroscopic techniques for qualitative analyses.*
6. *Use spectroscopic techniques for quantitative analyses.*

ASASC-503-2000 Analysis of Scientific Data and Information 1

Unit level (MQF): 5

Credits: 3

Unit Description

This is a skills and knowledge based unit that will allow learners to demonstrate that they have a proper understanding of the analysis of scientific information and data. Learners will initially be given a set of tools to be able to interpreate and manipulate data to fit theoretical outcomes required of their research. Emphasis will be placed on the ways of how data can be presented and illustrated, in both tabular and graphical forms.

This will be followed by emphasis on the processes of data processing, with a brief overview of numerical analysis of data. These skills are of vital importance in many chemical experiments that require rigorous manipulation of data.

Learners will be able to understand and solve data patterns to be able to give sound scientific evidence of their findings. In interpreting the data learners will then be also be able to visualize the data to increase the understanding and convey their findings to a larger audience.

Learning Outcomes

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

1. *Apply algebraic techniques to solve equations.*
2. *Use differentiation techniques to resolve problems in an analytical chemistry context.*
3. *Use integration techniques to resolve problems in an analytical chemistry context.*
4. *Use graphical and numerical methods to solve problems.*

ASCHM-506-2102 Introduction to Chemical Engineering

Unit level (MQF): 5

Credits: 6

Unit Description

This unit will introduce learners to the field of chemical engineering. A broad definition of chemical engineering and its benefits to society will be provided through an overview of the fundamental concepts. All aspects of physical, chemical and biochemical processes as found in traditional chemical engineering will be covered. Learners will be able to develop a basic understanding of the major topics in chemical engineering. Learners will learn the principles of scale-up, solve practical calculation problems, and analyse chemical engineering operations in terms of mass and heat balance, fluid flow, and the conservation laws.

Learners will be introduced to important practical and theoretical concepts in chemical engineering such as dimensional analysis, flow regimes, unit operations, heat transfer, process control, and risk assessment. Emphasis will be made on covering many different subjects in a general manner, rather than in detail. As an Introductory unit, one of the main aims is to render the learners familiar with the terms, concepts, reasoning and calculations used, rather than explain them in detail or apply them in difficult scenarios. Emphasis will be placed on relating the unit sub-topics to real world situations to give the learner an appreciation of chemical engineering principles in practice; the aim is to give learners an application-oriented knowledge. This approach is evident both in the learning outcomes and criteria which are listed, and in the assessment methods which are proposed.

Learning Outcomes

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

1. *Understand the basic principles of chemical engineering related to scale-up.*
2. *Solve practical calculation problems in chemical process technology.*
3. *Analyse unit operations in terms of Mass and Heat Balance.*
4. *Analyse Fluid Flow in terms of Conservation laws.*

ASENV-506-2101 Environmental Monitoring and Analysis

Unit level (MQF): 5

Credits: 6

Unit Description

This is a skills and knowledge based unit that will allow learners to demonstrate that they have a proper understanding of environmental monitoring and analysis. Learners will familiarise themselves with the methods in which pollutants are transferred between systems in the environment, these being either biotic or abiotic. Anthropogenic sources of these pollutants will also be covered, providing a detailed scrutiny of various anthropogenic activities that release different chemical pollutants in different environmental systems. In this context, numerous examples from the Maltese Islands will also be included, in order to allow learners to better visualise and familiarise with the concepts at hand.

The Unit is meant to provide a holistic insight into environmental monitoring and analysis, by firstly allowing learners to understand how the pollutants arrive, change and impact the environment, and how their different chemical qualities allow for their analytical study. Learners will also be exposed to sampling protocols inherent to environmental monitoring and analysis, followed by a review of the methods of how analytes are processed after being sampled. This module will be concluded by including a section on Maximum Permitted Levels of these analytes, which is of prominent importance when dealing with chemical species that are very persistent.

Learners will be able to complete an analytical experiment report, may be engaged in completing a research proposal and class presentation for this unit after following the content described below. The research proposal is meant to allow learners to interpret the contents of this module in a critical way, and applying this knowledge on a case study of their choice.

Learning Outcomes

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

1. *Describe different components of the environment.*
2. *Examine the sources and effects of environmental pollutants.*
3. *Apply sampling methods appropriate to an analyte.*
4. *Determine the concentration of analytes in samples.*

ASLAB-506-2101 Laboratory Management

Unit level (MQF): 5

Credits: 6

Unit Description

This unit provides learners with an excellent insight into the critical role and responsibilities of management within laboratory. It will also benefit those currently in other laboratory leadership roles as well as those interested in this career path. Laboratory managers, supervisors and team leaders play a pivotal role in the success of the laboratory.

The unit will provide the learners with the concepts of effective leadership, management and communication. It will describe different types of laboratory scenarios and will provide an overview of quality management. It will highlight the importance of standard reference materials to deliver reliable and consistent results.

It will explain the way a laboratory is managed financially, how to prepare for a successful budget and potential problems which may arise. The unit will also address the cost of quality and will cover purchasing and stock control.

The unit will cover the health and safety issues within a laboratory environment. It will highlight the current local OHSA and international regulations such as REACH and COSHH.

The unit will also address the requirements to consider when refurbishing or setting up a new laboratory from the design stage to organizing the work stations, services, bench space and storage

Learning Outcomes

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

1. *Explain the requirements of an effective laboratory manager*
2. *Identify what makes up a laboratory.*
3. *Maintain effective financial management in the laboratory.*
4. *Determine the health and safety compliance needs in the laboratory.*
5. *Manage aspects of organisation of laboratories.*

ASPRJ-506-2008 Research methods within a research project 1

Unit level (MQF): 5

Credits: 6

Unit Description

This unit will cover aspects of research methods used in research. The aim is to introduce learners to research and develop their understanding and skills in both quantitative and qualitative research methods. Learners will be introduced to the research process and apply different methodologies, data collecting tools and conceptual frameworks. The end-point of the module is the submission of a Statement of Intent (Proposal) for a research project in-line with College Regulations. This unit in meant to be followed by Research Methods 2.

In this study-unit, learners will cover different types of research design including experimental, descriptive and observational designed. Qualitative data collection designs to be introduced include archival studies, interviews and case studies. The methodological applications of these methods, including the design of appropriate research questions, will also be covered.

The syllabus also covers the challenges of various data collection techniques as well as the measurement issues of questionnaire development, reliability and validity of data, issues of sampling and of sampling size.

Following completion of this unit, learners should be familiar with all parts of the research process including funding application, ethics and publication. Tools will be provided for the learner to individually formulate a research question and to write a sound research proposal.

Learning Outcomes

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

1. *Describe the main stages of the research process.*
2. *Select the appropriate research design for a research question.*
3. *Compile a suitable ethical protocol.*
4. *Complete a research proposal for a specific research project.*

ASWBL-503-2007 Work Based Experience 1

Unit level (MQF): 5

Credits: 6

Unit Description

This skills-based unit will allow learners to demonstrate that they have the necessary skills to be able to work in a chosen science industry. Learners will be able to identify a suitable placement for themselves, make effective contact with potential employers and produce proposals for meaningful work that benefits both the learner and the employer. They will familiarise themselves with the work practices and tasks expected of them during the placement and negotiate their role in the organisation for the duration of their placement.

Learners will also be able to fully understand the implications of working within time, budgetary and legislative constraints. Amongst the skills developed are: effective time management (planning and organising on a daily basis and on a longer term project), and working independently and within teams. As regards legislative constraints, learners will have the opportunity to familiarize themselves with the regulatory mechanisms and industry standards in place in order to work effectively and safely with the organisation. By the end of the unit, learners would have developed a reflective practice and understanding of how to improve their efficiency in the workplace.

Learning Outcomes

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

1. *Identify a suitable and sustainable job.*
2. *Prepare all the requirements before applying for the job.*
3. *Identify the specific requirements of the placement.*
4. *Undertake work experience as identified.*

ASCHM-506-2001 Advanced Chemical Laboratory Techniques 2

Unit level (MQF): 5

Credits: 6

Unit Description

Advanced Chemical Laboratory Techniques is taught over two modules (1 and 2). This is the second module and covers the principles of chromatographic and titrimetric analysis. The learner is expected to use and consolidate the knowledge gained in Advanced Chemical Laboratory Techniques 1 and build on it.

This unit is designed to develop learners in a range of laboratory skills that extends from MQF/EQF Level 4 Chemical Laboratory Techniques and Advanced Laboratory Techniques 2. Learners will learn how products are separated, identified and the purities are determined using chromatographic techniques. Spectroscopic techniques covered in Advanced Chemical Laboratory Techniques 1 will be consolidated. Thorough risk assessments will be carried out for all practical work and the results acquired will be analyzed and presented in the form of a scientific report.

In a world of increasing Health and Safety regulations, it has become mandatory for Science Laboratory workers to follow the most stringent procedures for handling normal and hazardous substances and dispose of them appropriately. Learners will gain autonomy to analyses experimental procedures, research hazards and risks involved using Material Safety Data Sheet (MSDS) and completing Control of Substance Hazardous to Health (COSHH) forms and risk assessments.

Products obtained by chemical synthesis will be identified using spectroscopic and chromatographic methods as well as titrimetric analysis for determining concentrations and purities. Learners will acquire presentation skills throughout this unit by writing laboratory reports using Scientific Journal format as well as making presentations using PowerPoints and posters.

On completion of the unit learners will gain competence in many aspects of synthetic and instrumental chemistry commonly used in the research laboratory environment.

Learning Outcomes

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

1. *Conduct risk assessments for the use of chemical reagents, with particular focus on solvents used for chromatography and reagents used for titrations.*
2. *Understand the fundamental principles of chromatographic techniques*
3. *Perform qualitative analyses using chromatographic techniques*
4. *Perform quantitative analyses using chromatographic techniques.*
5. *Prepare standard solutions.*
6. *Use the main titrimetric methods for quantitative analyses.*

ASASC-503-2001 Analysis of Scientific Data and Information 2

Unit level (MQF): 5

Credits: 6

Unit Description

This is a skills and knowledge based unit that will allow learners to demonstrate that they have a proper understanding of the analysis of scientific information and data. Learners will initially be given a set of tools to be able to interpreate and manipulate data to fit theoretical outcomes required of their research. Emphasis will be placed on the ways of how data can be presented and illustrated, in both tabular and graphical forms.

This will be followed by emphasis on the processes of data processing, with a brief overview of numerical analysis of data. These skills are of vital importance in many chemical experiments that require rigorous manipulation of data.

Learners will be able to understand and solve data patterns to be able to give sound scientific evidence of their findings. In interpreting the data learners will then be also be able to visualize the data to increase the understanding and convey their findings to a larger audience.

The Unit will also introduce learners to the many statistical data analysis methods commonly employed. Descriptive statistics and other simple statistical tools will be covered, as well as methods of data distribution. In addition, this unit will allow learners to familiarise with statistical tests, which are of paramount importance in the scientific field. In order to allow them to fully grasp the content of these data processing tools, learners will practice these analytical techniques firsthand. Lastly, learners will be providing important insight into the presence and existence of errors in the analysis process. This is a vital component of the unit, especially when discussing how analysis conclusions should be framed.

Learners will be able to complete two separate assessments and employ most of these tools and techniques listed in the course description below.

Learning Outcomes

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

1. *Understanding data types.*
2. *Process data using statistics.*
3. *Present information and data according to scientific standards.*
4. *Use scientific methods to test statistical data.*

ASCHM-506-1509 Principles of Spectroscopy and Chromatography

Unit level (MQF): 5

Credits: 6

Unit Description

The objectives of this unit are: to provide an overview of analytical techniques (atomic and molecular spectroscopic techniques) appropriate for the modern chemical analysis; to develop the use of spectroscopy in chemical analysis; to develop the use of gas and High Performance Liquid Chromatography as a separation and analytical techniques; to discuss how combination of techniques are required in building up strategies for the analysis of compounds; and to develop a basic understanding of analytical validation.

In the spectroscopy part of the course, the students will learn about the electromagnetic spectrum, the relationship between the frequency/wavelength and energy, the dual nature of electromagnetic radiation; interaction between electromagnetic radiation and matter resulting in the electronic transitions, in atoms and molecules, from the ground state to higher energy (absorption) levels and back to lower energy levels (emission). Students will learn about the underlying theory and the instrumentation involved in: Atomic absorption and emission spectroscopies; Visible and Ultraviolet absorption and emission spectroscopies; Infrared spectroscopy; Nuclear Magnetic Resonance (NMR) spectroscopy and Mass spectroscopy.

In the chromatography part of the unit, the students will learn about the factors that determine the respective molecules' elution time along the chromatographic plate or from a chromatographic column, namely mass, boiling point, and chemical interactions {related to the functional groups present} of the eluting molecules.

The students will learn about the constituent parts of the instruments and their purpose; how a sample is prepared prior to being inserted into the instruments; how the prepared sample is actually inserted into the instruments, and what physically and chemically happens to the sample constituents during the analysis process inside the instruments. The ultimate aim is for students to learn how to perform analysis and interpret correctly the results given by the instruments.

Learning Outcomes

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

1. *Explain the fundamental theory of spectroscopy*
2. *Apply the fundamental theory towards the various spectroscopic techniques*
3. *Explain the fundamental theory of chromatography*
4. *Apply the fundamental theory towards the various chromatographic and combined techniques (e.g. Gas Chromatography and Mass Spectroscopy.)*

ASCHM-506-2105 Industrial Chemistry

Unit level (MQF): 5

Credits: 6

Unit Description

The aim of this unit is to give the learner a broad overview of the chemical industry and introduce concepts of chemical engineering which are expanded upon in other units within the course. The unit aims to bridge the gap between academia and the manufacturing industry. Therefore, this unit could be classified as interdisciplinary with regards to the skills required, as the learner is expected to seek knowledge in other subjects such as physics, chemical engineering, biotechnology, health and safety and economics to fully appreciate the complexity of a wide range of chemical processes.

Learners will be given an overview of the global chemical industry and shown that it is a crucial player to practically all manufacturing industries. Its financial and socio-economic value shall also be highlighted, as well as giving learners an insight into the major global players in the sector. Learners will be provided with an outline of the petroleum industry and taxonomy to aid in the classification of chemicals and their manufacturing processes, as well as fundamental tools utilized by chemical engineers, to aid in the understanding of plant design and operation.

This unit will also give an overview of emerging technologies in the field such as production of biofuels and the use of biotechnological processes within the chemical industry.

Learners shall become familiar with different levels and basic characteristics of industrial chemical production, fundamentals of chemical industrial processes and infrastructure requirements. Ultimately, this level 5 unit aims to gear learners with the fundamental tools used in the chemical industry to be proficient in understanding a wide range of process plants, should the learner visit or be employed in one.

Learning Outcomes

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

1. *Evaluate chemical production processes.*
2. *Analyse the processing of raw materials and production of organic chemicals and polymers.*
3. *Examine production of industrial inorganic chemicals, metals and the use of catalysts.*
4. *Recognise the concept of biotechnology and new emerging fields.*

ASCHM-506-1513 Medicinal Chemistry

Unit level (MQF): 5

Credits: 6

Unit Description

Learners will discover how to apply chemical and scientific principles to the process of drug discovery, drug action, drug design and drug manufacturing. Through this unit candidates will understand that the action of drugs depends on concepts such as hydrophilicity and hydrophobicity, hydrogen bonding, polarity, ionization, electronegativity, acid-base properties, pH, pKa, stereochemistry, kinetics, molecular size and other physico-chemical properties.

Drug action at receptors and enzymes will be studied. Using the appropriate chemical principles learners will consider the pharmacokinetic and pharmacodynamic properties of drug molecules.

Structure-activity relationships will be explored. Students will look into examples of natural sources of drug molecules and learn about the variety of modern drug discovery techiques.

The understanding of the principles of medicinal chemistry will be consolidated through the use of case-studies on the development of actual drugs and through practical sessions examining the physico-chemical properties of drug substances.

Learners will appreciate the process of drug development from laboratory to manufacture to patient, with a look at the EU directives, regulations and guidelines on new drug applications, clinical trials and drug manufacturing. Chemical and toxicological principles will be applied to the process of cleaning of manufacturing equipment, with an introduction to the use of toxicity, potency, dose and other concepts in calculations to determine acceptable carry-over limits from one product to another. Learners will also learn about how the expiry dates of medicines can be determined using chemical concepts.

Learning Outcomes

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

1. *Explain the action of drugs at enzymes and receptors and the relationship between drug structure and chemical properties and drug action;*
2. *Explain the factors that affect a drug's absorption, distribution, metabolism and excretion;*
3. *Describe the drug discovery and manufacturing process, including examples of natural sources of drug molecules;*
4. *Appreciate the role of biologically active molecules in biochemical systems and aspects of drug safety.*

ASCHM-506-1514 Quality Assurance and Quality Control

Unit level (MQF): 5

Credits: 6

Unit Description

Laboratories exist for a number of reasons ranging from supporting manufacturing processes and providing contractual services through to areas such as high performance forensic and research analytical services. The credibility of test results from an Analytical Laboratory is fundamental to its reputation and sustainability. This unit provides Learners with the opportunity to understand the related concepts and issues. The critical roles of Quality Control (QC), Quality Assurance (QA) and Quality Management System (QMS) accreditation are covered.

For those who may be unfamiliar with the difference between the principles of Quality Control and Quality Assurance the terms will be defined at the outset. Where possible, field trips to a variety of different specialized Laboratories settings may be used to help bring the subject to life, stimulate student discussion and embed the learning.

In essence, the unit covers the validity of analytical results, the power and use of internal and external Quality Control processes, the power and use of Quality Assurance processes and the value of Laboratory accreditation to specific related industry standards.

Learning Outcomes

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

1. *Explain the validity of analytical results in a quality framework*
2. *Use Quality Control methods in Laboratory analysis*
3. *Use Quality Assurance methods in a Laboratory setting*
4. *Explain the benefits of Laboratory accreditation*

ASPRJ-506-2009 Research methods within a research project 2

Unit level (MQF): 5

Credits: 6

Unit Description

This unit will cover further aspects of research methods used in research. The aim is to help the learners collect data, analyze it, and draw meaningful conclusions from it. The end-point of the module is the submission and presentation of a Level 5 research project in-line with College Regulations. The learners will be encouraged to complete a project as a pilot to a larger research endeavor such as a thesis. This unit in meant to be preceded by Research Methods 1.

The quantitative part of the unit will address research questions in terms of statistical concepts. Methods such as descriptive statistics, estimation and confidence intervals and inferential statistical tests such as chi-square, t-tests and ANOVAs for both parametric and non-parametric data will be covered. Skills in using statistical software such as SPSS will also be developed.

In this study-unit, learners will learn to organize and format a research report in line with College Regulations. This might include the preparation and presentation of a research poster. Techniques for presenting research during a viva or other similar scenarios will also be taught. Skills in compiling and writing a Literature Review will be covered. Preparation and proper formatting of Tables and Figures will also be taught.

Following completion of this unit, learners will have experienced the research process, and will be able to express their experiences and findings in a suitable format.

Learning Outcomes

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

1. *Use qualitative and/or quantitative methodologies.*
2. *Apply research methods, including a correct sampling method, taking into consideration issues such as reliability, validity, and bias.*
3. *Use the appropriate Software for processing and analyzing results.*
4. *Compile a research report based on own research endeavors.*

ASWBL-503-2008 Work Based Experience 2

Unit level (MQF): 5

Credits: 3

Unit Description

This skills-based unit will allow learners to demonstrate that they have the necessary skills to be able to work in a chosen science industry. Learners will be able to identify a suitable placement for themselves, make effective contact with potential employers and produce proposals for meaningful work that benefits both the learner and the employer. They will familiarise themselves with the work practices and tasks expected of them during the placement and negotiate their role in the organisation for the duration of their placement.

Learners will also be able to fully understand the implications of working within time, budgetary and legislative constraints. Amongst the skills developed are: effective time management (planning and organising on a daily basis and on a longer term project), and working independently and within teams. As regards legislative constraints, learners will have the opportunity to familiarize themselves with the regulatory mechanisms and industry standards in place in order to work effectively and safely with the organisation. By the end of the unit, learners would have developed a reflective practice and understanding of how to improve their efficiency in the workplace.

On a different note, this unit will also provide the learner the ability to use instruments and apparatus in an environment relevant to their chosen field of scientific work.

Learning Outcomes

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

1. *Reflect and evaluate on the workplace experiences that might lead to future employment.*
2. *Identify targets and goals for future employment.*
3. *Use communication and presentation skills to provide briefs, reports and presentations in line with current professional standards.*
4. *Identify personal abilities and employability attributes to plan a career pathway.*

ASCHM-606-2002 Analytical Chemistry

Unit level (MQF): 6

Credits: 6

Unit Description

This unit will enable the learner to discuss analytical chemistry and define its major strands of quantitative and qualitative analysis. The learner would be able to define the different separation techniques available depending on the sample being analysed, followed by titrimetric and gravimetric analysis as purely quantitative techniques while using chromatography and spectroscopy to addressing both qualitative and quantitative objectives. The learner shall recognise what data is to be collected from which technique, how to process data, present data and how results are to be interpreted. In relation to data processing, the learner shall be able to demonstrate what errors are to be considered, calculated and thus used for result evaluation. The learner shall attain the ability to compare between accuracy and precision of methods and explain the necessity of attaining both qualities in a method. The learner shall also be able to describe what system is to be utilised for the calibration of methods and equipment in the principle methods of analysis.

All parts of the unit shall focus on the provision of a sound insight into the chemical basis of the principles of the various analysis techniques such that the learner is able to justify the use of one technique over the other. Subsequently, upon unit completion, the learner shall be able to address a task for analysis, explain which techniques that would be required to generate the required results, devise a method outline and ensure validation.

Learning Outcomes

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

1. *Select appropriate separation techniques as part of the analytical process;*
2. *Measure analyte content using titrimetric and gravimetric analysis;*
3. *Understand the principles and theory behind Chromatography;*
4. *Interpret data obtained from analyses*

ASCHM-606-1515 Chemical Reaction Engineering

Unit level (MQF): 6

Credits: 6

Unit Description

This unit addresses the major steps at the heart of most chemical processes, i.e. chemical reactor design.

The unit reviews the fundamental concepts of thermodynamics and kinetics relevant to chemical reactors design and the different types of reactors that are likely to be encountered in the course of designing a chemical process. The learners are then introduced to the techniques required to carry out mass and energy balances for reactors other than ideal ones.

The subject of catalysis is covered in depth and topics such as mechanisms and kinetics of catalytic reactions, catalysts classification, formulation, preparation, structure, surface area, pore size distribution, adsorption, mass and heat transfer in catalytic reactors, resistances, diffusion, pore models, effectiveness factor, catalyst deactivation and regeneration are discussed. Both heterogeneous and homogeneous catalysis will be covered.

Mass transfer with chemical reaction in multiphase systems will provide the introduction to the discussion of the design of fixed-bed catalytic reactors and transport reactors as well as other types of multiphase reactors.

The stoichiometry and kinetics of reaction in biological systems will be covered and the students will be taught the design procedures for biochemical reactors.
Special attention will be paid to non-ideality in chemical reactors with mathematical treatment of residence time distribution in real reactors.

The module emphasise the importance of safety in reactor design and discusses the relevant inherently safe design issues as well as the dangers of fire, explosion and accidental release of material.

Learning Outcomes

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

1. *Understand homogeneous reactions in ideal reactors.*
2. *Understand non-ideal flow in reactors.*
3. *Understand reactions catalysed by solids.*

ASCHM-606-1516 Chemical Engineering Thermodynamics

Unit level (MQF): 6

Credits: 6

Unit Description

Through this unit, the learner will learn how to apply the principles of classical thermodynamics to chemical engineering problems. He will learn about the application of First and Second Laws of Thermodynamics including thermodynamic cycles, closed and open systems. The unit aims to establish the general thermodynamic principles and key relations that are essential to description of material and energy transfer processes that occur in typical chemical plant equipment.

The application of basics of classical thermodynamics to transient open and closed systems, criteria of stability and equilibria will also be covered including phase and chemical equilibria of multicomponent systems. The principle elements include the adaptation of the laws of thermodynamics to depiction of various flow processes, the mathematical description of phase and chemical reaction equilibria and illustration of their application. Applications are emphasized through extensive problem work relating to practical cases.

Learning Outcomes

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

1. *Apply the first and second law of thermodynamics in an engineering context;*
2. *Apply equations of state and fundamental thermodynamic relationships in an engineering context;*
3. *Understand fundamental phase equilibria laws in an engineering context;*
4. *Apply fundamental laws of chemical reaction equilibria in an engineering context.*

ASENG-606-1518 Fundamentals of Engineering and Process Engineering

Unit level (MQF): 6

Credits: 6

Unit Description

Chemical engineers are concerned primarily with process engineering involving the conversion of raw materials into valuable products. The products can include pharmaceuticals, specialized plastics, petrochemicals, materials for biomedical applications, and energy. The learner of the unit will cover these processes, which usually start out at a small laboratory scale and later developed for production at a large chemical plant scale.

The unit discusses material and energy streams in the process covering raw materials and their preparation, outlining the different operations involved, the separation of products and treatment of unreacted feed and by-products.

The learner will be acquainted with the graphical symbols used for equipment, piping and instrumentation diagrams. The equipment that forms the building blocks of any process will be introduced. This will cover process equipment such as stirred tank reactors, separators, heat exchangers, pumps, compressors and electric motors. The unit also covers the material used for chemical equipment and the learners will be taught how to protect it from corrosion and maintaining it.

Reactors for chemical transformation of gases, liquids and solids will be covered. Other process related equipment such as electrical, mechanical and civil engineering elements will be presented.

Learning Outcomes

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

1. *Understand elementary equipment used in chemical production.*
2. *Understand material used for chemical production.*
3. *Understand the role of other engineering fields in the chemical industry.*
4. *Understand the principles of unit operations in chemical industry.*

ASCHM-606-1517 Mechanical Operations

Unit level (MQF): 6

Credits: 6

Unit Description

This unit introduces the learner to the principles and practices involved in contacting, conveying, separating and storing single and multiphase systems. It includes the flow of incompressible fluids in conduits and past immersed bodies, as well as the transportation, metering, and mixing of fluids. Unit operations involved in the contacting and physical separation of phases, such as fluidisation, sedimentation and centrifugation, evaporation and membrane separation are also studied.

This unit also provides a thorough introduction to particle technology. The unit begins with understanding particle characterisation, the fluid mechanics of single and multi-particle systems and particulate fluidisation. The physics underlying powder flow will be covered to enable introductory hopper design. Common powder processing operations will be studied, selected from powder mixing/segregation, sedimentation, dewatering and size enlargement.

After completing this unit, the student will be able to understand particle characterisation techniques and how the motion and fluid mechanics of a single particle and multi-particle assemblies are affected by particle properties. The student will be able to select a suitable particle characterisation method; manipulate particle size distribution data; model particle flow in fluids and fluidized beds; and be able to use particle properties to design a suitable powder hopper to ensure powder flow. Finally, the student will understand the underlying principles of several powder processing operations, be able to design the key parameters for that unit operation and develop an appreciation for the complexities of powder handling and processing.

Learning Outcomes

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

1. *Understand solids characterisation, handling and particle size reduction in an engineering context.*
2. *Understand the principles of communition and different types of equipment for size reduction.*
3. *Understand engineering aspects of sedimentation, fluidisation and filtration processes.*
4. *Understand mixing processes.*

ASASC-606-1503 Process Modelling and Computing

Unit level (MQF): 6

Credits: 6

Unit Description

This unit introduces learner to modern computational and mathematical techniques for solving problems in chemical engineering. Leaners will be able to apply computational techniques to solve a wide range of numerical problems arising in Chemical Engineering.

Learners will learn theory, algorithms, implementation, and analysis of output for numerical.

The aim of this unit is to teach learners how to apply computational methodologies to solve chemical engineering problems when no closed-form, analytical solution exists. Achievement of this aim requires learning the basics of structured programming as well as learning how to combine engineering knowledge, judgment, and intuition to develop reasonable approximations through the engineering modelling process. Because mathematical judgment and approximations are involved, the material in this unit will be somewhat more open-ended than the material covered in other unit. Emphasis will be placed on understanding the basic concepts behind the various numerical methods studied and implementing basic numerical methods.

Learning Outcomes

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

1. *Differentiate and integrate numerically.*
2. *Solve an equation/-s with one or more variables.*
3. *Apply approximation theory in a chemical engineering context.*
4. *Solve ordinary and partial differential equations in a chemical engineering context.*

ASCHM-606-1518 Separation Processes

Unit level (MQF): 6

Credits: 6

Unit Description

This unit provides a focus on the separation processes that are part of the core knowledge and problem solving skills basis for chemical engineering unit operations. Each of these separation processes will be examined in detail and their application in a range of industries including oil and gas, pharmaceutical, food and environmental remediation.

This unit provides the learner with the fundamentals governing a range of separation processes such as absorption, distillation, humidification, leaching, liquid extraction and adsorption. The learner will apply the knowledge to the design and evaluation of these separation processes.

The overall aim is to provide a deep understanding of the general fundamentals such as mass and energy balances, phase equilibria and transport kinetics, and of how these principles are applied in design of separation processes in the process industry and in clean technology. The learners will get insight into the considerations that have to be balanced in finding a suitable solution to a specific separation problem. The aim is that the learner will also reach understanding of how this knowledge can be applied to separations in other situations, in particular in environmental systems.

The unit comprises fundamentals, basic requirements, and design principles for separation processes. Detailed descriptions and analyses of common unit operations are given. The fundamental mechanisms of phase equilibria and mass and/or heat transport and how the mathematical description of these mechanisms can be used in the design are also treated, as well as matters concerning the practical design of apparatus.

The unit also includes more empirical design methods, primarily for stage apparatus and continuous apparatus for common unit operations. The unit includes design of separation processes for process industry and for clean technology, as well as the application of the methods to other systems - in particular environmental systems. The course has particular emphasis on energy efficiency and the environment.

Learning Outcomes

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

1. *Understand separation by phase addition or creation.*
2. *Understand separations by barrier and solid agents.*
3. *Understand separations that involve a solid phase.*

ASCHM-606-1519 Transport Phenomena

Unit level (MQF): 6

Credits: 6

Unit Description

Transport Phenomena is the subject which deals with the movement of different physical quantities such as momentum, energy and mass in any chemical process and combines the basic principles (conservation laws) and laws of various types of transport. This unit provides learners with the fundamentals to solve problems involving transports of momentum, energy and mass in chemical systems using a unified approach. Although all these fields are developed separately throughout the history of science and technology, the learner will study these transport phenomena together due to following reasons:

- These transport phenomena occur frequently and most of the time simultaneously in industrial problems.
- All type of transport phenomena can be explained by similar transport and conversion laws. Physical properties which are used to describe transport laws like kinematic viscosity, thermal diffusivity or mass diffusivity play similar role.
- The mathematical requirements for solving problems related to transport phenomena are more or less similar.

This unit will also acquaint the learner with important topics in advanced transport phenomena (momentum, heat and mass transport). Topics include laminar and turbulent flow, thermal conductivity and the energy equation, molecular mass transport and diffusion with heterogeneous and homogeneous chemical reactions. Focus will be to develop physical understanding of principles discussed and with emphasis on chemical engineering applications. In addition to the text, the learner will be exposed to classic and current literature in the field.

The main objective of this unit is to give basic knowledge of transport phenomena one by one. The basic laws of transport phenomena like the Newton's law of viscosity or the Fourier's law of heat conduction or the Fick's law of diffusion are taken up at appropriate places. Basic axioms of conservations namely conservation of momentum, energy and mass are used for deriving simple shell balances and then the basic equations of transport phenomena are derived. Since this is a unit meant for undergraduate students, solutions of some simple engineering problems which can be solved analytically are studied.

Learning Outcomes

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

1. *Understand momentum transport*
2. *Understand energy transport*
3. *Understand the mass transport*

For further information, please contact us on information@mcast.edu.mt.