MCAST

MQF Level 4

AS4-A2-21

Advanced Diploma in Applied Science

Course Specification

Course Description

This course is designed for students who wish to embark on a scientific and technological career in a range of possible industries and professions such as within petrochemical, life sciences, health, pharmaceutics, environment and general engineering. The programme contains a wide range of science and technology units that reflect aspects of employment within science-based organizations.

Students will learn to appreciate how the fundamental principles of science relate to the technological operations of the workplace. They will develop the skills to work in a laboratory environment, manufacturing industry, to work with environmental technologies and methodologies, and to apply basic engineering principles within the workplace.

Programme Learning Outcomes

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

1. Follow and communicate procedures in the scientific workplace.

2. Use scientific techniques to understand technological processes within an organization.

3. Understand how science-based organizations develop products and deliver services.

4. Understand the requirements of science technicians in an organization.

Entry Requirements

MCAST Diploma in Applied Science

or

4 SEC/O-Level/SSC&P (Level 3) passes from: English language, Mathematics, Physics, Chemistry, Biology, Design and Technology, Health and Social Care

Current Approved Programme Structure

Unit Code	Unit Title	ECVET/ECTS	Year
ASAPS-406-1501	Fundamentals of Science	6	1
ASAPS-406-1502	Working in the Science Industry	6	1
ASAPS-406-1503	Scientific Investigations	6	1
ASAPS-406-1504	Perceptions of Science	6	1
ASAPS-406-1505	Microbiological Practical Techniques	6	1
ASAPS-406-1507	Science for Environmental Technicians	6	1
ASLAB-403-2000	Chemical Laboratory Techniques 1	3	1
ASAPS-406-1508	Resource Based Training	6	1
ASWBL-403-2000	Work Based Module 1	3	1
CDKSK-406-2001	English	6	1
CDKSK-406-2007	Mathematics	6	1
ASAPS-406-1506	Practical Chemical Analysis	6	2
ASLAB-409-2000	Chemical Laboratory Techniques 2	9	2
ASCHM-406-1501	Industrial Chemical Reactions	6	2
ASCHM-406-1502	Industrial Applications of Organic Chemistry	6	2
ASWBL-409-2000	Work Based Module 2	9	2
ASAPS-406-1509	Energy Changes, Sources and Applications	6	2
ASELE-406-1517	Electrical Circuits and their Applications	6	2
CDKSK-404-1915	Employability and Entrepreneurial Skills	4	2
CDKSK-402-2104	Community Social Responsibility	2	2
CDKSK-406-2109	Information Technology	6	2
Total ECVET/ECTS		**120**	

ASAPS-406-1501 Fundamentals of Science

Unit level (MQF): 4

Credits: 6

Unit Description

The aim of this unit is to enable learners to gain a broad theoretical and practical knowledge of chemistry, biology and physics. The science technicians in industries require a working knowledge and skills to use science.

The focus of this unit is on linking scientific principles with practical applications in engineering, medical and other scientific fields. Learners will know the structure of atom and ionic bonding to form molecules. They will understand the chemical reactions and ionic bonding of atoms. Learners will know the structure and function of cell membrane, cell wall, nucleus and nucleolus. They will understand the nature of tissues and their functions.

Students will study different forms of energy and differentiate between potential energy and kinetic energy. They will learn how energy changes from one form to another and understand the nature of heat and transfer of heat. Learners will know the nature of electric charge, electric current and electric circuits. They will know the electromagnetic spectrum, nature of light, sound, ultrasound and uses of X-rays.

Learners will perform experiments in chemistry, biology and physics. They will do titration, use microscope to identify cells and communicate results in their own work place as well as in other organizations to share the knowledge by means of reports and scientific papers.

Learning Outcomes

On completion of this unit learners will be able to

1. *Use chemicals in scientific and industrial work.*
2. *Use the knowledge of structure and functions of cells and tissues in biological and Medical fields.*
3. *Use different types of energy efficiently.*
4. *Communicate to share the scientific information.*

ASAPS-406-1502 Working in the Science Industry

Unit level (MQF): 4

Credits: 6

Unit Description

This is a skills based unit that will allow learners to demonstrate they have the necessary skills to be able to work effectively, efficiently and safely in a scientific environment. Students will be able to identify and carry out standard procedures in the scientific workplace safely in well-designed and operated work spaces and to communicate all aspects of the day-to-day running and data handling requirements of a variety of scientific workplaces. Students will also familiarize themselves with the regulatory and legislative requirements placed upon the scientific community to protect individuals and the environment.

The Unit is relevant to learners wishing to develop their knowledge of working in the science industry. On completion of the unit learners will understand how to design and operate a scientific laboratory within given specifications and regulations. They will be able to monitor and maintain a variety of instruments, stocks and datasets, using ICT where appropriate. This unit will provide the Learner with the ability to a use a variety of standard instruments and apparatus found in a range of scientific laboratories, to assess risks and store records and data associated with these activities and to clearly communicate organisational and scientific information to relevant parties.

Learners will carry out research and analysis tasks to further their understanding of working successfully within the science industry.

Finally, learners should have the underpinning knowledge and understanding to recognise and establish good laboratory practice in a variety of scientific disciplines within the science industry.

Learning Outcomes

On completion of this unit learners will be able to:

1. *Explain how procedures are followed and communicated in the scientific workplace.*
2. *Design a scientific laboratory to meet given specifications.*
3. *Describe the use of laboratory information management systems in the workplace.*
4. *Demonstrate safe working practices in the scientific workplace.*

ASAPS-406-1503 Scientific Investigations

Unit level (MQF): 4

Credits: 6

Unit Description

This is a skills based unit that will allow learners to demonstrate they have the necessary skills to be able to work effectively, efficiently and safely in a scientific environment. Students will be able to identify and carry out a scientific investigation using standard, and perhaps some more specialised, procedures in the laboratory safely. They will be able to communicate their results and evaluation of their investigation using recognised protocols and appropriate language. Students will also undertake risk assessments of their experimental work and familiarize themselves with the regulatory and legislative requirements of their chosen field of investigation.

The Unit is relevant to learners wishing to develop their knowledge of working in a scientific research environment. On completion of the unit, learners will understand how to design and carry out a scientific investigation safely and effectively. They will be able to construct hypotheses, design and carry out experimental procedures, collect, analyse and present data, using ICT where appropriate. This unit will provide the Learner with the ability to a use a variety of standard instruments and apparatus found in scientific laboratories in their chosen field, to assess risks and store records and data associated with these activities and to clearly communicate scientific information.

Learners will carry out research in preparation of their investigations to ascertain the extent previous work and to construct a bibliography to assist their investigation.

Finally, learners should have the underpinning knowledge and understanding to recognise and follow good laboratory practice in a scientific discipline of their choice.

Learning Outcomes

On completion of this unit learners will be able to

1. *Consider a specific area of study and plan a scientific investigation relating to the specified study area.*
2. *Use relevant scientific principles, and carry out the planned investigation.*
3. *Collect results from the investigation, then collate and assess them.*
4. *Interpret the results gained and consider conclusions.*

ASAPS-406-1504 Perceptions of Science

Unit level (MQF): 4

Credits: 6

Unit Description

This is a theoretical unit that will allow learners to demonstrate an understanding of how science is perceived by the wider public. Students will understand the process of scientific research and development. They will be able to evaluate sources of information for a range of target audiences based on use of language, writing styles, detail and accuracy of science reporting. They will develop an awareness of the moral issues, ethical issues, benefits and drawbacks of scientific advances. Finally, learners will develop an appreciation of the way science is funded and the benefits and pressures this brings to scientists and society from a variety of official, pressure and interest groups.

Learners wishing to develop their understanding of the role and perception of science in society will find this unit of relevance. On completion of the unit learners will understand how science can be reported and the effects of this on various target groups. They will be able to make informed decisions about current scientific advances and ongoing research and have an awareness of how science has developed historically and continues to develop currently. They will understand how financial, commercial and political influences affect current and future scientific developments and be able to state examples where this has occurred.

Learners will carry out research; undertake reading and surveys to allow them to become conversant with current popular science research, debate and attitudes towards this in the wider public. This will allow them to develop an overview of the way that science is perceived in society, develop their own opinions on scientific research and the associated ethical and moral considerations and improve their ability to recognise factual use and reporting of science in the wider context.

Finally, learners should have the underpinning knowledge and understanding to confidently address the perceptions and value of current and future scientific developments.

Learning Outcomes

On completion of this unit learners will be able to:

1. *Explain how scientists develop scientific ideas.*
2. *Describe the ways in which the media influence the way that members of the public perceive science.*
3. *Investigate some scientific advances and the moral and ethical issues raised by them.*
4. *Explain the relationships that exist between politics, commerce and science.*

ASAPS-406-1505 Microbiological Practical Techniques

Unit level (MQF): 4

Credits: 6

Unit description

This is a skills based unit and will allow learners to demonstrate they have the necessary skills to be able to understand the processes involved in the culture and growth of a range of micro-organisms. Students will be able to identify micro-organisms, their structures and functions, growth requirements and culture under aseptic conditions. They should understand that micro-organisms are ubiquitous and hence food and beverage, pharmaceutical, environmental and medical industries need to ensure sterility. However, certain food and beverage and pharmaceutical industries need microorganisms to create their products. They will develop a familiarity with microscopes and other equipment routinely used in the microbiology laboratory and how micro-organisms are contained and safely disposed of.

The Unit is relevant to learners wishing to further develop their knowledge of micro-organisms, their culture and use in biotechnology and biomedical industries. On completion of the unit, learners will understand how to identify, count, contain and culture a range of micro-organisms, as well as developing the understanding, knowledge and skills required to use microbiological techniques and equipment.

Learners will carry out laboratory procedures in order to prepare, count and identify a range of micro-organisms, providing a broad understanding of the operation of a microbiology laboratory.

Learning Outcomes

On completion of this unit learners will be able to

1. *Identify the characteristic features and functions of prokaryotic and eukaryotic cells.*
2. *Culture a range of micro-organisms using aseptic techniques.*
3. *Determine and state factors which influence micro-organisms growth.*
4. *Recognize the range of pathogenic and useful microorganisms and their roles in various biotechnology industries.*

ASAPS-406-1506 Practical Chemical Analysis

Unit level (MQF): 4

Credits: 6

Unit description

From food labelling to drug analysis, analytical chemistry plays a key role in identifying chemical substances in a mixture and detecting trace elements. There are many applications of analytical chemistry particularly in monitoring the quality of food and drug products during manufacturing processes and monitoring water quality and pollution in the environment. Analytical work used in industry must follow the processes and procedures to comply with Health and Safety legislation.

Determination of unknown quantities of a substance requires mathematical and practical skills that ensure accuracy. This often requires standards that can be used as reference points so that comparisons can be made with the unknown substance to determine its identity or quantify its value. For example, determination of the unknown concentration of a solution requires standard solutions with known concentration. Preparations of primary and secondary standard solutions require calculating the amount of solids needed for making up the stock solution. This stock solution can also be diluted to make a series of solutions with different concentrations. In this unit, the learners will discover the importance of standard solutions and the methods used to accurately determine the unknown concentration of substances.

Since the discovery of the properties of electromagnetic waves and their uses in spectroscopy, the spectroscopic techniques have become a powerful tool in detecting and identifying trace compounds in a sample. This detection of compounds will depend on the type of electromagnetic waves used, which will determine the amount of energy exerted onto the atoms and sub-atoms of compounds or the way they excite the electrons in a sample. For example, the functional groups of organic compounds are detected by the vibration of bonds within molecules by the infrared radiation whereas the detection of molecules by UV-visible spectroscopy is by the excitation of molecular electrons to a higher energy orbital. In this Unit, the learners will be given an opportunity to explore a range of spectroscopic techniques and analyse the data from these techniques to evaluate the properties of the unknown compound in question.

When you have a compound of interest in a mixture, it is often necessary to separate it from the mixture before identification. Chromatography is a selective procedure used to isolate the compounds according to their physical properties which can then be collected, identified and possibly quantified.

On completion of this unit, learners will gain a deep understanding of sample detection and identification using traditional and modern techniques.

Learning Outcomes

On completion of this unit learners will be able to:

1. *Prepare standard solutions and perform serial dilutions.*
2. *Use spectroscopic techniques to identify and quantify substances.*
3. *Use chromatographic techniques to separate, identify and quantify substances.*

ASAPS-406-1507 Science for Environmental Technicians

Unit level (MQF): 4

Credits: 6

Unit Description

The aim of this unit is to enable learners to gain a broad theoretical and practical knowledge of the Earth science and Energy resources. The environmental technicians require a working knowledge and skills to use science.

The focus of this unit is on linking scientific principles with practical applications in environmental studies. Learners will study the movement of Earth, composition of atmosphere, ozone layer in stratosphere, climate change and global warming due to pollution. They will know the processes associated with the formation of soil and rocks, structure of the interior Earth, weathering and erosion. Learners will know the demand of water, its availability in Malta and vegetation. They will understand the importance of efficient system of water storage, water harvesting, water pollution and its treatment and supply.

They will understand the availability of non-renewable and renewable Energy resources. They will learn the method of using non-renewable energy to generate electricity. Learners will understand the importance of sustainability, extraction of materials, materials management, energy resources and its efficient use. They will know the impact of energy use on environment. Learners will know the techniques of waste management and re-cycling of waste materials.

Learning Outcomes

On completion of this unit learners will be able to:

1. Explain solar system and the climate of Earth.
2. Identify processes associated with soil and rock formation.
3. Explain water cycle and water management.
4. Explain management of materials and Energy resources.

ASLAB-403-2000 Chemical Laboratory Techniques 1

Unit level (MQF): 4

Credits: 3

Unit description

This unit is designed to develop learners in a range of laboratory skills that form the basis of good laboratory writing skills identification of organic and inorganic substances. A wide range of practical work will allow learners to demonstrate their ability to identify substances through separation and analysis.

Whatever the purpose of scientists, they must understand the importance of Health and Safety legislation. Through practical work, learners will gain autonomy to work safely in a science laboratory by wearing appropriate personal protective equipment (PPE) and following instructions when carrying out reactions and operating equipment. Learners will also master record keeping skills where observations and measurements are recorded using a suitable format. Identify risk hazards associated with the chemicals used, read and understand a MSDS and take the necessary precautions associated with the chemicals used.

Because of the complexity of chemical reactions, it is necessary for the learners to begin their journey using simple reactions with simple equipment to understand the key principles.

As learners become more experienced, improvements to the procedures can be considered. This may follow onto more complex techniques that are capable of producing increased accuracy, reliability, purity and yield. Calculation of atom economy of reactions should link to green chemistry which must be considered when choosing alternative methods.

On completion of the unit learners will gain competence in many aspects of wet chemistry and experience what it is like to work in a science laboratory.

Learning Outcomes

On completion of this unit learners will be able to

1. *Compile a practical report to understand MSDS.*
2. *Examine quantification of analytical substances including yield and purity, as well as accuracy and precision of techniques.*
3. *Identify organic and inorganic compounds using qualitative analysis.*
4. *Apply simple separation techniques followed by quantitative and qualitative analysis.*

ASCHM-406-1501 Industrial Chemical Reactions

Unit level (MQF): 4

Credits: 6

Unit Description

For a reaction to occur, two or more molecules must interact to cause a chemical change. However, no reaction would proceed unless the condition is suitable for the reactants. This is because for any reaction to take place, bonds have to be broken before a new one can be formed. The activation energy determines the feasibility of chemical reactions which is influenced by factors such as temperature, concentration of reactants, pressure of the reaction vessel and the presence of catalysts.

The energetics of the chemical reaction plays a vital role in determining the reaction conditions to make it economically viable. Because some reactions require a large supply of heat or release a vast amount of energy as a result of the reaction, the security issues must be considered in order to guarantee safety.

In this Unit, learners will initially look into enthalpy changes that take place during chemical reactions and discover why some factors influence the rate of reactions using particle models. This is followed by the study of the reaction kinetics that determines how fast the reaction would proceed and the chemical equilibrium of the reaction that determines how far the reaction would proceed to give the desired products.

Upon understanding the effects of factors on the chemical reactions learners will apply their knowledge on to industrial processes.

Through theoretical and practical approaches, this Unit will enable learners to discover the life of chemists in the manufacturing industry.

Learning Outcomes

On completion of this unit learners will be able to

1. *Calculate enthalpy changes from experimental and bond energy data.*
2. *Investigate how the factors affect the rates of chemical reaction.*
3. *Apply the principles of chemical equilibrium in the reaction systems.*

ASCHM-406-1502 Industrial Applications of Organic Chemistry

Unit level (MQF): 4

Credits: 6

Unit Description

This unit will begin with the basics of organic chemistry required for proper understanding of the industrial applications of different organic compounds. It will then introduce the learner to the classifications, nomenclature, structure, properties and industrial applications of organic compounds. Organic compounds such as petrochemicals and pharmaceuticals are extremely useful in everyday life for clothing, transport, and medicine among others and come from natural or artificial sources. In this unit, learners will be familiarised with these important organic compounds, their sources, chemistry and the industrial processes that make them useful.

Of particular interest in this unit are hydrocarbons which are organic compounds composed entirely of carbon and hydrogen. Learners will study their sources, physical and chemical properties, classifications, industrial processes and uses. Non-hydrocarbon organic compounds like ketones, alcohols and amines which are derivatives of hydrocarbons will also be studied, here learners will learn about bonding and functional groups which are responsible for the properties of these organic compounds.

The carbon atoms of organic compounds can bond with metals as well to form organometallic compounds; learners will study organometallics and their properties. Emphasis will be placed on the industrial processes and reactions of organic compounds hence, learners will learn about the organic compounds used as starting materials in organic synthesis, their conversion into other organic compounds, the kinds of reactions they undergo and important commercial uses.

Learning Outcomes

On completion of this unit learners will be able to:

1. *Explain the diversity of organic compounds.*
2. *Describe industrial hydrocarbon processes.*
3. *Discuss the properties of non-hydrocarbon organic compounds.*
4. *Examine types organic reactions and their commercial importance.*

ASAPS-406-1508 Resource Based Training

Unit level (MQF): 4

Credits: 6

Unit description

This is a skills based unit that will allow learners to demonstrate they have the necessary skills and knowledge of the basic laboratory techniques and processes to work in line with the current GxP relevant to laboratory practices.

The Unit is relevant to learners wishing to develop further their knowledge of working in a laboratory within a science based industry. The applications of analytical chemistry are various and wide ranging – however the principles are similar and relevant to various laboratories.

Upon completion of the unit, learners will be able to carry out a number of qualitative and quantitative tests using standard, and perhaps some more specialised, procedures in the laboratory. Learners will understand how to carry out procedures accurately and precisely and be aware of how changes in procedure can have an effect on the result obtained. They will also be able to use a wide range of laboratory equipment which are applicable to both the general aspect of science laboratories and also for more specific areas of study such as microbiology, the food industry, pharmaceutical or environmental laboratories. They will be able to communicate the used methodology and results using recognised protocols and appropriate language. Furthermore, all testing will need to be carried out in line with the current Health and Safety legislation.

Learning Outcomes

On completion of this unit learners will be able to:

1. *Carry out procedures accurately and precisely.*
2. *Demonstrate how analysis is used in a specific area of study.*
3. *Operate a range of analytical equipment in the laboratory.*
4. *Follow GxP relevant to laboratory practice.*

ASWBL-403-2000 Work Based Module 1

Unit level (MQF): 4

Credits: 3

Unit Description

This is a skills-based unit that prepares the learner to prepare for a place of work. The learner will be given hands-on training to master various basic skills and techniques to be able to work within the scientific workplace. The focus of the unit is to assess the learner's technical competences through an accredited assessment methodology compromising of a series of established learning outcomes and respective grading criteria. In addition, the learners will be given the opportunity to enhance soft skills to be able to function better at the place of work.

Learning Outcomes

On completion of this unit the student will be able to

1. *Recognise the importance of different sectors within the science-related industry.*
2. *Prepare for a job application.*
3. *Prepare for a job interview.*
4. *Assess legally binding documents.*

ASAPS-406-1509 Energy Changes, Sources and Applications

Unit level (MQF): 4

Credits: 6

Unit Description

This unit enables learners to gain a broad theoretical and practical knowledge of energy changes whilst develop skills and knowledge. The technicians and professionals working in industries require a working knowledge and skills to use science. This unit fuses on linking scientific principles with engineering and practical applications.

Learners will know the force and its unit derived from the first principles of mechanics. They will understand the work done by application of force and energy used. Energy can change from one form to another; learners will understand the transformation of energy by working quantitatively. They will learn the gravitational potential energy, kinetic energy and electrical energy and their applications.

Learners will understand the importance of energy and its efficient use. They will know the different forms of energy including renewable and alternate energy, impact of energy use on environment and climate change.

They will learn the nature of solar radiation and know how to use it for heating water with different kinds of materials. They will know the absorption coefficient and thermal conductivity of materials. They will also know the use of solar radiation for generating electricity using photo-voltaic cells, storing it in electrical batteries and distributing it using inverters and transformers.

Learning Outcomes

On completion of this unit learners will be able to

1. *Explain the nature of force, work and energy.*
2. *Explain the nature of heat and temperature.*
3. *Explain the process of conduction, convection and radiation.*
4. *Explain the nature and generation of electrical energy.*

ASELE-406-1517 Electrical Circuits and their Applications

Unit level (MQF): 4

Credits: 6

Unit Description

This unit aims to allow learners to gain a broad theoretical and practical knowledge of electricity and its application in electrical circuits. The technicians and professionals in industries require a working knowledge of electrical circuits and skills to use scientific principles. They should know the basic electrical quantities, their fundamental units and derivatives.

This unit focusses on linking scientific principles with practical applications in engineering, industrial and medical fields. Learners will know the nature of atom, molecules, electron flow, direct current flow and alternating current. They will know the network theorems, single-phase series circuits and single-phase parallel networks. They will understand working of electrical instruments, equipment and their components.

Learners will understand the importance of energy and its efficient use. They will know the function of electromagnetic machines which links an electrical energy system to another energy system in its magnetic field. Learners will know the working of converters and transducers. They will know the analogue instruments and digital meters. They will understand the operation of graphical display devices and working of cathode ray oscilloscopes (CROs). They will know the health and safety requirements in laboratories and relevant regulations and how it applies in the electrical work.

Learning Outcomes

On completion of this unit learners will be able to

1. *Explain and know the basic electrical quantities.*
2. *Explain and know the working of parallel & series electrical circuits.*
3. *Explain and know the direct current and alternating current circuits.*
4. *Explain and know the transducers and measurement devices.*

ASLAB-409-2000 Chemical Laboratory Techniques 2

Unit level (MQF): 4

Credits: 9

Unit Description

This unit is designed to advance the learners' skills within a laboratory setting. The unit aims to further develop the learners' writing and research skills, with special importance given to the synthesis, extraction, quantification, and analysis of organic and inorganic substances. A wide range of practical work will allow learners to demonstrate their ability to identify substances through separation and analysis.

Similar to unit carried out in semester 1, learners will gain autonomy to work safely in a science laboratory by wearing appropriate personal protective equipment (PPE) and following instructions when carrying out reactions and operating equipment. Learners will also master record keeping skills where observations and measurements are recorded using a suitable format. Identify risk hazards associated with the chemicals used, read and understand a MSDS and take the necessary precautions associated with the chemicals used.

This unit is targeted for more experienced learners, whereby the learner is expected to show possible improvements to the procedure and good time management which is essential in any industrial setting. Full data analysis including accuracy, reliability, purity and yield are to be expected from the learners in this credit.

On completion of the unit, learners will gain competence in many aspects of analytical, physical and organic chemistry and experience what it is like to work in a science laboratory.

Learning Outcomes

On completion of this unit learners will be able to

1. *Understand the concepts of physical chemistry through experiments.*
2. *Recognise the various routes for organic and inorganic synthesis.*
3. *Recognise the concepts of various forms of analytical wet chemistry.*
4. *Apply various forms of advanced separation techniques.*

ASWBL-409-2000 Work Based Module 2

Unit level (MQF): 4

Credits: 9

Unit Description

This is a skills-based unit that prepares the learner to work in industry and reflect on performance and preferences. The learner will be given hands-on training to master various basic skills and techniques to be able to work in the scientific workplace. The focus of the unit is to assess the learners' technical competences through an accredited assessment methodology consisting of a series of established learning outcomes and respective grading criteria. In addition, the learner will be given the opportunity to enhance own soft skills to be able to enhance the work experience.

Learning Outcomes

On completion of this unit learners will be able to

1. *Undertake a work-related experience.*
2. *Review the work experience.*
3. *Deal with challenges that arise in scientific-related employment.*
4. *Implement financial literacy.*

ASCHM-406-2106 Practical Chemical Analysis

Unit level (MQF): 4

Credits: 6

Unit Description

Food labelling, drug analysis, product development, analysing environmental samples, awareness of instrumentation and the ability to carry out calculations, are all essential skills for chemists, laboratory analysts and technicians.

Determination of unknown quantities of a substance requires mathematical and practical skills that ensure accuracy. This often requires standards that can be used as reference points so that comparisons can be made with the unknown substance to determine its identity or quantify its value. For example, determination of the unknown concentration of a solution requires standard solutions with known concentration. Preparations of primary and secondary standard solutions require calculating the amount of solids needed for making up the stock solution and making dilutions.

Analysts should be aware of different units and measures used in chemistry, and how to interpret results from various techniques, from titrations, column, paper and thin layer chromatography, to modern instrumental techniques.

Learning Outcomes

On completion of this unit learners will be able to

1. *Prepare standard solutions, perform calculations for dilutions and use various units of concentration and different types of titrations.*
2. *Perform calculations for reactions involving gases, limiting reactants, percentage yield and, molecular and empirical formulae.*
3. *Use various spectroscopic techniques to identify and quantify substances.*
4. *Use chromatographic techniques to separate, identify and quantify substances.*