GQA PAA\VQSET Level 3 Certificate in Laboratory Technical Skills

600/1545/7

Centre Qualification Handbook

Knowledge-based Qualifications

AUGUST 2021 V1

GQA, Unit 1, 12 O' Clock Court, Attercliffe Road, Sheffield, S4 7WW
Tel: 01142 720033, Email: Info@gqaqualifications.com,
Website: www.gqaqualifications.com

CONTENTS PAGE

INTRODUCTION TO THE HANDBOOK

This qualification sits within the Regulated Qualifications Framework (RQF).

This Qualification Handbook has been developed to ensure that GQA Centres understand the requirements of the qualification. The Handbook contains the following information:

- Qualification Structure
- Process of Assessment
- Glossary
- Qualification Units

This Qualification Handbook has been developed to provide support in the implementation of the qualification as well as giving information to ensure that the assessment and quality assurance is consistent, robust and reliable within each centre and nationally. The handbook also contains details of the skills and/or knowledge the learner must obtain to achieve the units and qualification.

Qualification Structure

This section of the handbook summarises the content of the qualification and the skills and/or knowledge learners that achieve it can be expected to gain. It also outlines the units required to achieve the qualification and will give the learner an idea of how long the qualification will take to achieve through the Total Qualification Time (TQT) and how much contact time they can expect through the Guided Learning Hours (GLH). It also provides information about possible progression opportunities once the qualification has been achieved.

Process of Assessment

The process of assessment outlines how the qualification will be assessed; this may be via an externally set examination, completion of a workbook or assignments, written or practical exercises, or a combination of these.

Qualification Units

The unit overview summarises the content of the unit and the skills and/or knowledge the learner will have gained on achievement of the unit. The units may also contain additional information in the assessment context which will describe the areas to be covered.

Qualification Assessment and Support Materials

Centres will be sent the following qualification assessment and support materials:

- Registration Spreadsheet
- Learner Guide
- Qualification Handbook

If the qualification is assessed by external examination and/or Internal Assessments, centres will also receive:

- Mock Examination and Answer Paper
- Internal Assessments and Scoring, if appropriate
- Internal Assessments Results Sheet, as appropriate

LEVEL 3 CERTIFICATE IN LABORATORY TECHNICAL SKILLS

Qualification Summary

This qualification introduces laboratory-related supervisory systems and procedures together with advanced technical skills in specialist areas of science and technology. It covers knowledge of laboratory Health, Safety and Environmental practices; managing operations within the laboratory and advanced laboratory procedures.

Total Qualification Time (TQT) and Guided Learning Hours (GLH)

Guided Learning Hours (GLH)

Guided Learning Hours are the time the learner is under the immediate supervision or guidance of a lecturer, supervisor, tutor or other appropriate provider or education or training.

The GLH for this qualification is 180

Total Qualification Time (TQT)

Total Qualification Time is comprised of 2 elements:

1. GLH
   plus
2. an estimate of the number of hours a learner will reasonably be likely to spend in preparation, study or any other form of participation in education or training, including assessment, which takes place as directed by (but not under the immediate supervision of) a lecturer, supervisor, tutor or other appropriate provider or education or training

The TQT for this qualification is 250

Achieving the Qualification

Learners must achieve 3 Mandatory Units and a minimum of 2 Optional Units.

Mandatory Units

Unit No.	Unit Name	Credit Value
CLTS3 01	Laboratory Health, Safety and Environmental Practices	4
CLTS3 02	Manage Operations within the Laboratory	3
CLTS3 03	Advanced Laboratory Procedures	8

Optional Units

Learners must achieve a minimum of 2 Optional Units.

Unit No.	Unit Name	Credit Value
CLTS3 04	Biological and Biochemical Laboratory Techniques	5
CLTS3 05	Chemical Laboratory Techniques	5
CLTS3 06	Physic Laboratory Techniques	5
CLTS3 07	Laboratory Workshop Techniques	5
CLTS3 08	Laboratory Photography and Audio-Visual Aids	5
CLTS3 09	Good Manufacturing Practice (GMP)	5
CLTS3 10	Chromatography	5

Progression

The Certificate in Laboratory Technical Skills is available at Levels 2 and 3.

Further information can be found on the GQA website www.GQAQualifications.com or on the Register of Regulated Qualifications website http://register.ofqual.gov.uk

PROCESS OF ASSESSMENT

The learner will undertake internal and external assessments as shown below.

Internal Assessment

The assessment of the Level 3 Certificate in Laboratory Technical Skills will be by an Internal Assignment undertaken by the Centre and an external examination set by GQA. The Internal Assignment will be provided by GQA along with marking criteria, recording materials and guidance. The Internal Assignments will be externally verified by GQA will also provide a mock examination paper, and answer paper, to enable learners to prepare and revise for the external examination.

External Assessment

The external examination will be taken by the learner at the GQA approved Examination Centre and all learners must be registered with GQA for the qualification.

Examinations will be conducted in accordance with GQA's requirements to maintain national standards and rigorous quality assurance.

The questions have been developed by subject experts from the sector and directly relate to the unit requirements contained in this Qualification Handbook. For learners to achieve the Level 3 Certificate in Laboratory Technical Skills they must achieve a pass in both the Internal Assessments and the external examination. Should a learner not pass all the required units from a qualification they will receive a unit certificate for the units they have achieved and will need to register to re-sit the failed units. Once all units have been achieved a certificate for the full qualification can be issued.

Examinations will be held at predefined dates as shown on GQA's Examination timetable. Subject experts, provided by GQA, will mark and moderate all examination papers returned by the Examination Centres and Centres will be notified of the results.

Centres will be externally verified by GQA to ensure that internal assessments and external examinations at the Centre have been conducted at the required standard.

Further information regarding GQA's requirements for Externally Examined Knowledge-based qualifications can be found in the Centre Portfolio.

GLOSSARY

Term	Definition
Access Arrangements	Arrangements that are approved in advance of an examination or assessment to allow achievement to be demonstrated by learners with a disability, special learning needs (including where the learner's first language is not English, Welsh or Irish) or to avoid unlawful discrimination
Appeal	The process through which an awarding organisation may be challenged on the outcome of an enquiry about results or, where appropriate, other procedural decisions affecting a centre or an individual learner
Assessment	The process of making judgements about the extent to which a learner's work meets the requirements of a unit, or any additional assessment requirements of a qualification
Assessor	A person who assesses a learner's work
Award of Qualifications	A certificate (electronic or paper-based) issued to an individual that recognises their achievement
Award	A qualification with a TQT value between 10 and 129
Awarding Organisation	A body recognised by the qualifications regulators to award qualifications
Centre	An organisation accountable to an awarding organisation for assessment arrangements leading to the award of qualifications
Centre Recognition	A process through which a centre wishing to offer an award or awards is confirmed as being able to maintain the required quality and consistency of assessment, and comply with other requirements of the awarding organisation
Certificate (1) for a Unit or Qualification	A record of attainment of a qualification issued by an awarding organisation
Certificate (2)	A qualification with a TQT value between 130 and 369
Credit	An award that may be made to a learner in recognition of the achievement of a unit or qualification
Credit Value	The number of credits that may be awarded to a learner for the successful achievement of a unit or qualification
Diploma	A qualification with a TQT value of 370 or above
Guided Learning Hours	The number of hours of teacher-supervised or directed study time required to teach a qualification or unit of a qualification
Learning Time	The amount of time a learner at the level of the unit is expected to take, on average, to complete the unit to the standard required

Term	Definition
Level	An indication of the relative demand, complexity and/or depth of achievement, and/or the autonomy of the learner in demonstrating that achievement
Mandatory Units	Units that must be achieved for the qualification to be awarded
National Occupational Standards (NOS)	Describe what a person needs to do, know and understand in a job to carry out the role in a consistent and competent way
Optional Unit	A unit that a learner may choose to complete to achieve the required number of units for award of the qualification
Pathway	A route to the achievement of a qualification that requires particular units to be achieved and is identified by an endorsement to a qualification title
Qualification	An award made to a Learner for the achievement of the required units or other components for that qualification
Qualification Level	An indication of the relative demand, complexity and/or depth of achievement, and/or the autonomy of the learner, represented by a qualification
Qualifications Regulators	Government-designated statutory organisations required to establish national standards for qualifications and secure consistent compliance with them
Recognition of Prior Learning (RPL)	A method of assessment that considers whether a learner can demonstrate that they can meet the assessment requirements for a unit through knowledge, understanding or skills they already possess and do not need to develop through a course of learning
Sector Skills Council	A body responsible for formulating and reviewing occupational standards for a specific sector across the UK, and for supporting the development of units and qualifications based on these standards. Each SSC is an employer-led, independent organisation and is licensed by government
Standardisation Of Assessment	A process to ensure that assessment leading to the award of qualifications is applied consistently by individuals, centres and awarding organisations
Unique Learner Number (ULN)	The unique number that is used to identify an individual learner
Unit	A component of a qualification

LEVEL 3 CERTIFICATE IN LABORATORY TECHNICAL SKILLS

CONTENT OF THE QUALIFICATION

MANDATORY UNITS

UNIT CLTS3 01	**LABORATORY HEALTH, SAFETY AND ENVIRONMENTAL PRACTICES**
LEVEL	**3**
CREDIT VALUE	**4**
GUIDED LEARNING HOURS	**25**

Unit Overview

This unit addresses the knowledge required to work in a laboratory environment in a safe manner.

This unit will cover knowledge of:-

- Complying with legislation and Codes of Practice
- Assessing and controlling risks arising from normal activities
- Health, Safety and Environmental Policies
- Procedures for managing emergencies and incidents
- Managing materials

Assessment Context

Comply with legislation and Codes of Practice, to include:-

- Health and Safety at Work etc. Act and Regulations
- EU Directives
- Environmental protection requirements
- Nationally-recognised Codes of Practice
- Employer's requirements and how they apply to the working environment
- Locally-devised requirements
- Good housekeeping practices
- Environmental, Health & Safety Audits

Assess and control risks arising from normal laboratory activities, to include:-

- Risk assessment procedures and documentation
- The methods used for collection and handling of information about hazards
- The measures to control hazards and risks[1]
- The special assessments (as applicable to own organisation), e.g. COSHH, DSEAR, manual handling, DSE
- The specification and maintenance of personal protective equipment
- The specification of additional controls, as appropriate
- The management of personnel visiting the laboratory area to perform work in the area(2)

[1] e.g. fume cupboard, safety screen, safety cabinet, personal protection for body, hands and eyes, safe working practices, handling chemicals, performing analysis

[2] e.g. maintenance and calibration of facilities, services and equipment, repairs to equipment, services or facilities, installation of equipment or services

Health, Safety and Environmental Policies, to include:-

- The organisations policies and procedures
- Departmental policies, guidance and operating procedures
- The organisations procedures/processes for updates and amendments
- The organisations safe systems of work
- Roles and responsibilities of self and others with regard to policies and procedures

Procedures for managing emergencies and incidents, to include:-

- Control/management and treatment of spillage
- Evacuation criteria for immediate and wider work areas
- Emergency aid for laboratory injuries
- Emergency procedures and First Aid treatment
- The criteria for reporting accidents and dangerous occurrences under RIDDOR[1]
- The analysis of accident and near-miss statistics
- Management of procedures and processes for the segregation and disposal of waste
- The process for making improvements to operating procedures

[1] Reporting of Injuries, Diseases and Dangerous Occurrences Regulations

Manage Materials, to include:-

- The effects of environment (heat, light, moisture, etc.) on materials[1]
- Storage and segregation requirements
- Safe and appropriate handling
- Safe and efficient transport of chemicals and other materials
- Handling, storage and disposal of waste
- Disposal of used/unwanted materials
- Identification and management of Special Waste
- Segregation of waste
- Reduction in the generation of waste

[1] Biological (living and dead), chemicals, paper products, electronic media, consumables, sharps, rechargeable cells

Learning Outcome and Assessment Criteria

Learning outcomes **The learner will:**	**Assessment criteria** **The learner can:**
1. Understand relevant legislation and codes of practice	1.1. Explain the statutory legislation that is appropriate to laboratories 1.2. Describe the European Union (EU) Directives that are appropriate to laboratories 1.3. Explain the Environmental protection requirements that affect laboratories 1.4. Describe nationally-recognised Codes of Practice that affect laboratories 1.5. State an employer's legislative requirements and how they apply to the working environment 1.6. Describe the organisation's good housekeeping practices 1.7. Explain the purpose of Environmental, Health and Safety audits
2. Understand how to assess and control risks within a laboratory	2.1. Describe risk assessment procedures and documentation 2.2. Describe the methods used for the collection and handling of information about hazards 2.3. Explain the measures to control hazards and risks 2.4. Describe the special assessments required to meet legislative requirements 2.5. State the specification and maintenance of Personal Protective Equipment (PPE) 2.6. Describe the management of personnel visiting the laboratory
3. Know Health, Safety and Environmental policies for the laboratory	3.1. State the organisation's Health, Safety and Environmental policies and procedures 3.2. Explain the application of departmental policies, guidance and operating procedures 3.3. Describe the organisation's procedures/processes for updates and amendments 3.4. Describe how the organisation's safe systems of work are applied in the laboratory 3.5. Explain the roles and responsibilities within the laboratory with regard to policies and procedures
4. Know procedures for managing emergencies and incidents	4.1. Describe the control, management and treatment of spillage within the laboratory 4.2. State the evacuation criteria for immediate and wider work areas 4.3. Describe the emergency aid treatment provided for laboratory injuries 4.4. State the procedure for reporting accidents and dangerous occurrences as required under legislation 4.5. Explain how to analyse accident and near-miss statistics

5. Know how to manage materials	5.1. Explain the effect environment may have on materials in a laboratory 5.2. Describe the management of storage and segregation requirements within a laboratory 5.3. Describe how to manage the safe and efficient transport of chemicals and other materials 5.4. Explain how to manage the handling, storage and disposal of waste 5.5. Explain how to manage the identification and management of Special Waste

UNIT CLTS3 02	**MANAGE OPERATIONS WITHIN THE LABORATORY**
LEVEL	**3**
CREDIT VALUE	**3**
GUIDED LEARNING HOURS	**20**

Unit Overview

This unit addresses the knowledge required to manage work in a laboratory environment in a safe manner.

The unit will cover knowledge of:-

- Employment-related matters
- Communicating effectively
- Managing laboratories and related areas on a day-to-day basis
- Managing human and physical resources on a day-to-day basis

Assessment Context

Employment-related matters, to include:-

- Terms and conditions of employment and negotiating procedures/processes
- Grievance, disciplinary and capability procedures and how they are used in the organisation
- Duties of employer and employee
- Limits of authority
- Procedures/policies (e.g. Disability Discrimination, Equality and Diversity, child protection/protection for vulnerable adults)

Communicate effectively, to include:-

- How to Review, approve and write reports verbal
- Verbal communication – 1:1, groups
- Obtaining and handling data and information [1, 2]
- Data protection policy
- The presentation and explanation of data and information (written & verbal)– graphs, charts
- The use of electronic systems and the internet
- The use of personal computer and lap-top/notebook[4]

[1] from reference books, text books, catalogues, periodicals, specifications, internet, pharmacopoeias
[2] with regard to copyright legislation
[4] word processing, spreadsheets, databases, presentations

Manage laboratories and related areas on a day-to-day basis, to include:-

- Recognition and the implementation of legal/regulatory requirements[1]
- Paper-based and electronic records, e.g. stock, task lists, training, etc
- Monitoring and maintenance of facilities and services
- Compliance with ordering and accounting procedures
- The optimum layout of laboratories and associated facilities
- The management of stock and equipment

Manage human and physical resources on a day-to-day basis, to include:-

- The organisation of work schedules
- Dealing with requests from staff
- The supervision of technical staff
- The analysis and implementation of training and development needs of team and self
- Obtaining resources from other teams
- The allocation of rooms, equipment

[1] health and safety, purchasing, storage and disposal of ethanol/Industrial Methylated Spirits (if used in the organisation), radioactive materials(if used in the organisation), flammable solvents, hazardous chemicals, genetically-modified organisms, biological materials

Learning Outcome and Assessment Criteria

Learning outcomes The learner will:	Assessment criteria The learner can:
1. Understand employment-related matters that may affect the laboratory environment	1.1. Explain terms and conditions of employment and negotiating procedures/processes within the laboratory 1.2. Explain grievance, disciplinary and capability procedures and how they are used in the organisation 1.3. Explain the duties of employer and employee 1.4. Describe the limits of authority
2. Understand how to communicate effectively	2.1. Explain how to review, approve and write reports 2.2. Describe the various types of communication both internal and external that may be used 2.3. Describe the relevant sources of information where information may be obtained 2.4. Describe how information may be presented in a usable form
3. Understand how to manage laboratories and related areas on a day-to-day basis	3.1. Describe how to implement the legal/regulatory requirements for a laboratory environment 3.2. Describe the types of storage systems that may be used in a laboratory 3.3. Explain how to monitor and maintain facilities and services in a laboratory 3.4. Describe the ordering and accounting procedures required in a laboratory 3.5. Describe the optimum layout of laboratories and associated facilities 3.6. Describe the management of stock and equipment for a laboratory
4. Understand how to manage human and physical resources on a day-to-day basis	4.1. Explain how to organise work schedules 4.2. Explain how to analyse and implement the training and development needs of a team 4.3. Describe how to obtain resources from other teams, if necessary 4.4. Describe how to allocate facilities and equipment, if necessary

UNIT CLTS3 03	**ADVANCED LABORATORY PROCEDURES**
LEVEL	**3**
CREDIT VALUE	**8**
GUIDED LEARNING HOURS	**55**

Unit Overview

This unit addresses the knowledge required to undertake advanced laboratory procedures.

This unit will cover knowledge of:-

- Techniques for separation
- Techniques in microbiology
- How to prepare and test solutions
- How to locate and repair faults in equipment

Assessment Context

Techniques for separation, to include:-

- Filtration – under gravity, under vacuum, types of filter
- Distillation – simple, steam, reduced pressure, fractionation
- Theory and practice of chromatography – thin layer, GLC, HPLC, paper, ion
- Theory and practice of centrifugation
- Partition coefficient, solvent extraction, continuous extractors
- Theory and practice of electrophoresis

Techniques in microbiology, to include:-

- Aseptic technique
- Preparation and storage of media from commercial preparations and basic ingredients
- Methods for sterilisation (eg Autoclave) and disinfection (rotation of disinfectants and relative merits of each)
- Disposal of cultures and related materials
- Sources of information
- Classification and main characteristics of micro-organisms
- Potential sources of contamination

How to prepare and test solutions, to include:-

- Provision and monitoring of a supply of distilled, demineralised, purified water
- Calculation of quantities of solute and solvent and for serial dilution[1]
- Primary and secondary standards
- Non-aqueous solvents
- Complex solutions, e.g. stains, buffer solutions, isotonic and perfusion fluids (cover those applicable to own organisation and discipline)
- Properties of solutes[2]
- Detergents, antiseptics and disinfectants

[1] including moles, millimoles, parts per million, parts per billion, normal solutions
[2] anhydrous, hydrated, hygroscopic, deliquescent, efflorescent

How to locate and repair faults in equipment, to include:-

- Visual inspection
- Process for the identification of faults
- The estimation of cost of repair
- How to effect repair (in-house or by outside agency)
- Test equipment before returning to use
- Limitations of responsibility and capability

Learning Outcome and Assessment Criteria

Learning outcomes The learner will:	Assessment criteria The learner can:
1. Understand the techniques for separation	1.1. Explain the technique of filtration 1.2. Explain the technique of distillation 1.3. Describe the theory and practice of chromatography 1.4. Describe the theory and practice of centrifugation 1.5. Describe partition coefficient, solvent extraction, continuous extractors 1.6. Describe the theory and practice of electrophoresis
2. Understand the techniques in microbiology	2.1. Describe aseptic technique 2.2. Describe how to prepare media from commercial preparations and basic ingredients 2.3. Describe a method for sterilisation and disinfection 2.4. Describe how to dispose of cultures and related materials 2.5. List the classification and main characteristics of micro-organisms
3. Know how to prepare and test solutions	3.1. Describe how to provide and monitor supplies of test solution materials 3.2. Describe how to calculate the measured quantities of solution likely to be required for tests 3.3. Explain primary and secondary standards 3.4. Explain what non-aqueous solvents are 3.5. Describe a complex solution 3.6. Describe the properties of a solute 3.7. Describe the purpose of detergents, antiseptics and disinfectants
4. Know how to locate and repair faults in equipment	4.1. Describe how to undertake a visual inspection 4.2. Describe the procedure to identify faults and effect repairs 4.3. Describe the procedure for testing equipment prior to use 4.4. Explain limits of responsibility

OPTIONAL UNITS

UNIT CLTS3 04	**BIOLOGICAL AND BIOCHEMICAL LABORATORY TECHNIQUES**
LEVEL	**3**
CREDIT VALUE	**5**
GUIDED LEARNING HOURS	**40**

Unit Overview

This unit addresses the knowledge required to undertake biological and biochemical laboratory techniques.

This unit will cover knowledge of:-

- Experimental work in biotechnology and genetics
- Experimental work using enzymes and other biological molecules
- How to classify, collect and preserve biological material
- Techniques in microscopy
- Further techniques in microbiology
- How to conduct physiological experiments

Assessment Context

Experimental work in biotechnology and genetics, to include:-

- Cell division, mitosis, meiosis, chromosomes (including root tip squash)
- The principles of heredity
- Gene transfer
- Aseptic technique precautions
- Types of organisms used for genetics investigations
- Cloning plant material
- Safety as applied to handling Biological and genetic materials
- Disposal of materials
- Personal Protective Equipment (PPE) requirements
- Equipment and facilities utilised

Experimental work using enzymes and other biological molecules, to include:-

- The structure and function of enzymes
- Optimum conditions for enzyme activity
- Care, handling and storage of bio-active materials
- Isolation of DNA
- Protein purification and sequencing
- Gene amplification

How to classify, collect and preserve biological material, to include:-

- Naming systems for plants and animals
- The basic criteria for classifying plants and animals
- The legal requirements for collection of material from the wild
- The selection of suitable containers and means of transport
- The methods for long- and short-term preservation[1]
- Handling and disposal of dead and preserved material
- The use of fixatives and other toxic materials

[1] drying, chilling, freezing, pickling

Techniques in microscopy, to include:-

- The care of optical components
- Critical and Köhler illumination
- The calculation of total magnification of a specimen
- Temporary and permanent slides made from sections, squashes and smears
- Staining protocols
- 'hanging drop' slide for viewing in vivo specimens
- Counting and measuring cells
- Video/digital microscopy

Further techniques in microbiology, to include:-

- Pathogens and non-pathogens
- Culture of specific bacteria and fungi
- Use of slopes, broth cultures, streak plates
- Basic staining techniques for bacteria
- The preservation of cultures, e.g. refrigeration, freezing, freeze-drying
- The identification of bacteria
- Introduction to virology
- Environmental monitoring techniques

Identification of bacteria, to include:-

- How bacteria are identified using traditional methods such as staining, selective media, appearance of colonies on agar plates and observed shape under microscope.

Introduction to virology, to include:-

- The generalised structure and life cycle of a virus
- Main types of virus (DNA, RNA, phage) and common viruses such as HIV, common cold, tobacco mosaic virus

Environmental monitoring techniques, to include:-

- Procedures for monitoring clean room conditions
- What the causes of contamination might be and how contamination could be detected

How to conduct physiological experiments, to include:-

- Respiration, including use of spirometer
- Sensory investigations[2]
- Ethics and limitations for work on living specimens, including humans
- Cardiovascular measurements, ECG, pressure transducers, blood composition and analysis
- Renal physiology, analysis of Na, K, urea, glucose, osmolarity

[2] vision, hearing, kinesis, taste, smell, EEG

Learning Outcome and Assessment Criteria

Learning outcomes **The learner will:**	**Assessment criteria** **The learner can:**
1. Know how to support experimental work in biotechnology and genetics	1.1. Describe how cell division may occur 1.2. State the principles of heredity 1.3. Describe the process of gene transfer 1.4. List the types of organisms used for genetics investigations 1.5. Describe cloning plant material 1.6. State the required safety for handling biological and genetic materials
2. Know how to support experimental work using enzymes and other biological molecules	2.1. Describe the structure and function of enzymes 2.2. State the optimum conditions for enzyme activity 2.3. Describe the care, handling and storage of bio-active materials 2.4. Explain the isolation of Deoxyribonucleic Acid (DNA) 2.5. Describe protein purification and sequencing 2.6. Describe gene amplification
3. Know how to classify, collect and preserve biological material	3.1. Describe the naming systems for plants and animals 3.2. Describe the basic criteria for classifying plants and animals 3.3. State the legal requirements for collection of material from the wild 3.4. Describe how to select suitable containers and means of transport 3.5. Describe the methods for preservation 3.6. Describe how to handle and dispose of dead and preserved material 3.7. Describe how to use fixatives and other toxic materials
4. Know how to support and undertake techniques in microscopy	4.1. Describe how to care for optical components 4.2. Describe the purpose of illumination 4.3. Describe how to calculate the total magnification of a specimen 4.4. Describe how to make slides 4.5. State the staining protocols 4.6. Describe how to count and measure cells 4.7. Describe different types of microscopy
5. Know how to support and undertake further techniques in microbiology	5.1. Describe the types of techniques that may be used for investigations of organisms 5.2. Describe environmental monitoring techniques
6. Know how to support physiological experiments	6.1. Describe the types of testing equipment that may be used for physiological experiments 6.2. Describe the ethics and limitations for experiments on living specimens

UNIT CLTS3 05	**CHEMICAL LABORATORY TECHNIQUES**
LEVEL	**3**
CREDIT VALUE	**5**
GUIDED LEARNING HOURS	**40**

Unit Overview

This unit addresses the knowledge required to undertake chemical laboratory techniques.

This unit will cover knowledge of:-

- Titrimetric and gravimetric analysis
- Spectroscopic techniques
- Electrochemical techniques
- Thermochemical techniques
- Analytical techniques
- Analysis of inorganic and organic compounds

Assessment Context

Titrimetric and gravimetric analysis, to include:-

- Apparatus and techniques for titration (manual and automatic)
- Theory and use of indicators
- Common types of titration – acid/base, redox, thiosulphate, EDTA
- Apparatus and techniques used in gravimetric analysis
- Recording readings and performing calculations (by manual and/or electronic means)
- Selection, use and purpose of buffers

Spectroscopic techniques, to include:-

- Visible, infra-red and ultra-violet spectrophotometry
- The principles and components of each instrument
- The preliminary interpretation of results
- Other techniques, e.g. fluorimetry
- The principles of absorptiometry as applied to a colorimeter
- The maintenance and calibration requirements for each instrument

Electrochemical techniques, to include:-

- The theory and practice of conductimetric titrations
- The theory and practice of potentiometric titrations
- The theory and practice of Redox reactions
- Electrolysis (quantitative and qualitative) and electrochemical cells
- The theory of pH and the combination electrode
- The maintenance and calibration requirements for each instrument
- The care of electrodes

Thermochemical techniques, to include:-

- Energy changes in chemical reactions (Endothermic and Exothermic)
- The determination of enthalpies of reaction
- The function of Differential Scanning calorimetry and Differential Thermal Analysis techniques
- The effects of temperature on rate of reaction
- Sources of error in experimental work
- The maintenance and calibration requirements for each instrument

Analytical techniques, to include:-

- Physical indicators of purity
- The measurement of melting points, boiling points
- Qualitative tests to identify selected anions, metal ions and organic functional groups[1]
- Flame tests
- The fundamentals of refractometry
- The basic principles of HPLC
- Electrophoresis as an analytical tool

[1] chloride, bromide, iodide, carbonate, sulphate, nitrate, iron(II), iron(III), magnesium, zinc, copper, p-, sec- and tert-alcohols, aldehydes, ketones, amines, amides
[2] sodium, potassium, calcium, barium, copper

Analysis of inorganic and organic compounds, to include:-

- The preparation and analysis of inorganic compounds by neutralisation, precipitation,
- The preparation and analysis of organic compounds (aliphatic and aromatic)[1]
- The preparation and analysis of gases using different methods[2]
- The preparation and analysis of selection, use and care of small- and large-scale apparatus
- The preparation and analysis of common qualitative tests and reagents

[1] alcohol, aldehyde, acid
[2] small scale (test tube quantities), larger scale (gas jar quantities), collection over water, collection by upward/downward displacement of air, specialist drying agents

Learning Outcome and Assessment Criteria

Learning outcomes **The learner will:**	**Assessment criteria** **The learner can:**
1. Know how to perform titrimetric and gravimetric analysis	1.1. Describe the apparatus and techniques for titration 1.2. Explain the theory and use of indicators 1.3. State the common types of titration 1.4. Describe the apparatus and techniques used in gravimetric analysis 1.5. Describe how to record readings and perform calculations 1.6. Describe the selection and use of buffers
2. Know how to perform spectroscopic techniques	2.1. Describe spectrophotometry 2.2. State the principles and components of instruments used in spectrophotometry 2.3. Describe how to interpret preliminary results 2.4. Describe other techniques that may be used 2.5. State the principles of absorptiometry as applied to a colorimeter 2.6. Describe the maintenance and calibration requirements for each instrument
3. Know how to perform electrochemical techniques	3.1. State the theory and practice of conductimetric titrations 3.2. State the theory and practice of potentiometric titrations 3.3. Describe redox reactions 3.4. Describe electrolysis and electrochemical cells 3.5. State the theory of pH and the combination electrode 3.6. Describe the maintenance and calibration requirements for each instrument 3.7. Describe how to care for electrodes
4. Know how to perform thermochemical techniques	4.1. Describe the energy changes in chemical reactions 4.2. Describe how to determine the enthalpies of reaction 4.3. Describe the function of Differential Scanning calorimetry and Differential Thermal Analysis techniques 4.4. Describe the effects of temperature on rate of reaction 4.5. Describe how to investigate sources of error in experimental work 4.6. Describe the maintenance and calibration requirements for each instrument

5. Know how to perform analytical techniques	5.1. State physical indicators of purity 5.2. Describe the measurement of melting and boiling points 5.3. List the qualitative tests used to identify selected anions, metal ions and organic functional groups 5.4. Explain the use of flame tests 5.5. State the fundamentals of refractometry 5.6. State the basic principles of High Performance Liquid Chromatography (HPLC) 5.7. Describe how to use electrophoresis as an analytical tool
6. Know how to prepare and analyse inorganic and organic compounds	6.1. Describe the types of preparation and analysis of inorganic compounds 6.2. Describe the types of preparation and analysis of organic compounds 6.3. Describe the preparation and analysis of selection, use and care of small- and large-scale apparatus 6.4. Describe the preparation and analysis of common qualitative tests and reagents

UNIT CLTS3 06	**PHYSIC LABORATORY TECHNIQUES**
LEVEL	**3**
CREDIT VALUE	**5**
GUIDED LEARNING HOURS	**40**

Unit Overview

This unit addresses the knowledge required to undertake physic laboratory techniques.

This unit will cover knowledge of:-

- Experimental work in regions of the electromagnetic spectrum
- Experimental work in electricity and magnetism
- Experimental work using ionising radiations
- Experimental work in mechanics
- Experimental work in electronics

Assessment Context

Experimental work in regions of the electromagnetic spectrum, to include:-

- General description of main areas, including hazards and control measures
- The properties of waves
- Visible light[1]
- Microwaves
- Photoelectric cells
- Lasers and holography

[1] refraction/reflection, lenses and prisms, stroboscope, diffraction grating, prism spectrometer

Experimental work in electricity and magnetism, to include:-

- Hard and soft magnetic materials, magnetic fields
- Electromagnetic induction, electromagnet, dynamo, simple motor, transformer, alternator
- Electrostatics, Van de Graaff generator, electroscope
- Devising and connecting electric circuits, series and parallel
- Fixed and variable resistors
- The selection, use and care of rechargeable cells

Experimental work using ionising radiations, to include:-

- The types of emission, radioactive decay, half-life
- Health effects and safe practices
- The legal requirements for acquisition, storage and disposal of radioactive materials
- Open/unsealed and sealed sources
- The types of analysis using radioactive labels
- The principles and use of radiation detectors
- Atomic physics, electron discharge tubes, photoelectric effect, Planck's constant

Experimental work in mechanics, to include:-

- Statics, scalar and vector, equilibrium of forces, laws of friction
- Linear dynamics[1]
- Circular motion and gravitation
- Mechanical oscillations, SHM, resonance

[1] speed, velocity, acceleration, momentum, Newton's Laws of Motion

Experimental work in electronics, to include:-

- The identification of electronics components, colour codes, symbols, function
- Drawing and interpreting circuit diagrams
- The manufacture of printed circuit boards
- Construction techniques, soldering, correct use of tools
- Rectification circuits
- Semiconductors, transistors, amplifiers
- Logic circuits
- The safety measures when working with electronic equipment, including use of earthing straps and testing

Learning Outcome and Assessment Criteria

Learning outcomes **The learner will:**	**Assessment criteria** **The learner can:**
1. Understand how to support experimental work in regions of the electromagnetic spectrum	1.1. Describe the common types of radiation within the electromagnetic spectrum 1.2. Describe the properties of waves 1.3. Describe hard and soft magnetic materials and magnetic fields 1.4. Explain the possible health hazards associated with electromagnetic techniques
2. Understand how to support experimental work using ionising radiation	2.1. Describe the types of emission that can be expected from ionising radiation 2.2. State the health effects and safe practices required 2.3. Describe the legal requirements for acquisition, storage and disposal of radioactive materials 2.4. Describe how to handle open/unsealed and sealed sources 2.5. List the types of radioactive labels 2.6. State the principles and use of radiation detectors 2.7. List the types of techniques used for ionising radiation
3. Understand how to support experimental work in mechanics	3.1. Describe the types of techniques used in mechanics 3.2. List the hazards that may be encountered when working in mechanics 3.3. State the health effects and safe practices required when working with mechanical equipment
4. Understand how to support experimental work in electronics	4.1. Describe how to select electrical components 4.2. Describe how to interpret drawings and circuit diagrams 4.3. Describe the construction techniques and tools to be used 4.4. Describe the safety measures required when working with electronic equipment

UNIT CLTS3 07	**LABORATORY WORKSHOP TECHNIQUES**
LEVEL	**3**
CREDIT VALUE	**5**
GUIDED LEARNING HOURS	**40**

Unit Overview

This unit addresses the knowledge required to undertake laboratory workshop techniques.

This unit will cover knowledge of:-

- How to cut and shape materials
- How to fix materials using adhesives and engineered devices
- How to draw/sketch work pieces and work from diagrams/drawings
- How to maintain the workshop
- Hoe to implement and follow safe systems and procedures

Assessment Context

How to cut and shape materials, to include:-

- Wood, metal, cork, rubber, plastic, wire
- Hand and power tools
- Bench drill, saws and grinder
- Protective equipment and clothing
- Good working practices
- Good housekeeping
- Minimising waste
- Disposal/recycling of materials
- Correct Personal Protective Equipment (PPE)

How to fix materials using adhesives and engineered devices, to include:-

- The use of water- and solvent-based adhesives, impact adhesives, acrylics
- The use of nuts, bolts, screws, nails
- Soft soldering (using colophony-free solder)
- Safe working practices
- Minimising waste
- Disposal/recycling of waste
- Correct Personal Protective Equipment (PPE)

How to draw/Sketch work pieces and work from diagrams/drawings, to include:-

- Scale drawings
- Symbols and conventions
- Plan and elevation
- Computer aided design

How to maintain the workshop area, to include:-

- Good housekeeping
- The storage of materials, components, tools
- The security of work area, equipment and workpieces
- The storage and disposal of waste
- Servicing and maintenance of equipment
- Audit of Health and Safety requirements including good housekeeping

How to implement and follow safe systems and procedures, to include:-

- Risk assessment and control measures
- Good technique
- The inspection of tools, equipment and materials
- The selection of materials
- Keeping appropriate records

Learning Outcome and Assessment Criteria

Learning outcomes **The learner will:**	**Assessment criteria** **The learner can:**
1. Know how to cut and shape materials	1.1. Describe the types of materials that may be used 1.2. List the hand and power tools that can be used to cut and shape 1.3. Describe the protective equipment and clothing that should be used 1.4. Describe good working practices that should be used
2. Know how to fix materials using adhesives and engineered devices	2.1. Explain how to use various types of adhesives and their purpose 2.2. Describe other types of fixing techniques 2.3. Explain the relevant safe working practices
3. Know how to draw/sketch work pieces and work from diagrams/drawings	3.1. Describe how to use scale drawings 3.2. List the types of symbols and conventions used in diagrams and drawings 3.3. Explain the terms plan and elevation 3.4. Explain the advantages of computer aided design
4. Know how to maintain the workshop	4.1. Describe techniques of good housekeeping in a laboratory 4.2. Describe how materials, components and tools should be stored 4.3. Explain how to ensure the security of work area, equipment and work pieces 4.4. Describe how the storage and disposal of waste should be carried out 4.5. Explain how equipment should be serviced and maintained
5. Know how to implement and follow safe systems and procedures	5.1. Describe the requirements for risk assessment and control measures 5.2. Describe the procedures for the inspection of tools, equipment and materials 5.3. Explain the procedures for keeping appropriate records

UNIT CLTS3 08	**LABORATORY PHOTOGRAPHY AND AUDIO-VISUAL AIDS**
LEVEL	**3**
CREDIT VALUE	**5**
GUIDED LEARNING HOURS	**40**

Unit Overview

This unit addresses the knowledge required to undertake laboratory photography and audio-visual aids.

This unit will cover knowledge of:-

- How to set up and use recording/playback equipment
- How to recognise and use different types of camera and imaging systems
- How to produce photographic and electronic Images
- How to create visual aids
- How to set up and use sound systems
- How to maintain imaging, recording and playback equipment and materials
- Safe working practices

Assessment Context

How to set up and use recording/playback equipment, to include:-

- DVD
- Camcorder
- Webcam
- Data projector
- An interactive screen
- Computer

How to recognise and use different types of camera and imaging systems, to include:-

- Camcorder
- SLR camera
- Digital cameras (SLR, four-thirds, Bridge, compact zooms)
- The sensors used in digital cameras (1)
- CCTV
- An interactive screen
- An overhead projector

(1) Types: Full frame, APS-C, other types and the effect on image quality and focal length of the lenses in relation to the old 35mm SLR cameras

How to produce photographic and electronic Images, to include:-

- Creating monochrome contact prints
- Creating 1:1 digital images and prints
- Editing digital images
- The use and disposal of photographic chemicals and materials
- Printing methods for digital images

How to create visual aids, to include:-

- Atomic models (ball and stick)
- PowerPoint slides
- Using clip art
- Using a photocopier (enlarge, reduce, edit), monochrome and colour
- Creating display material[1]
- Copyright law

[1] posters, charts, graphs, histograms, diagrams

How to set up and use sound systems, to include:-

- Audio cassette recorder
- MP3 player
- The selection and use of amplifiers
- The selection and use of microphones
- Gain and feedback
- Types of loudspeakers

How to maintain imaging, recording and playback equipment and materials, to include:-

- Cleaning lenses
- The care of videotapes, CDs, audiotapes, DVDs, Hard Disk Drives and peripheral storage devices
- The care of stored electronic images
- The replacement of lamps and other user-accessible components
- The care and service requirements for equipment

Learning Outcome and Assessment Criteria

Learning outcomes **The learner will:**	**Assessment criteria** **The learner can:**
1. Know how to set up and use recording/playback equipment	1.1. Describe the types of recording/playback equipment that may be used in a laboratory 1.2. Describe the procedures for working safely with recording/playback equipment
2. Know how to recognise and use different types of camera and imaging systems	2.1. Describe the types of camera and imaging systems that may be used in a laboratory 2.2. Describe the procedures for working safely with camera and imaging systems
3. Know how to produce photographic and electronic images	3.1. Describe the types of photographic and electronic images that may be used in a laboratory 3.2. Describe the use and disposal of photographic chemicals and materials 3.3. Describe the procedures for working safely with photographic and electronic images
4. Know how to create visual aids	4.1. Describe the types of visual aids required to create display materials in a laboratory 4.2. Describe the purpose of copyright law
5. Know how to set up and use sound systems	5.1. Describe how to select appropriate sound systems in a laboratory 5.2. Describe the types of ancillary equipment that might be used with a sound system 5.3. Explain the terms ‘gain’ and ‘feedback’ in relation to sound systems
6. Know how to maintain imaging, recording and playback equipment and materials	6.1. Describe various cleaning techniques that can be used 6.2. Describe how to care for recording materials 6.3. Describe how to care for stored electronic images 6.4. Explain how to organise the care and service requirements for equipment

UNIT CLTS3 09	**GOOD MANUFACTURING PRACTICE (GMP)**
LEVEL	**3**
CREDIT VALUE	**5**
GUIDED LEARNING HOURS	**40**

Unit Overview

This unit addresses the knowledge required to understand the purpose of Good Manufacturing Practice (GMP) and other quality management systems.

This unit will cover knowledge of:

- The GMP regulations and how they relate to own organisation and the laboratory
- The purpose of documentation and its role in GMP compliance
- How the GMP regulations relate to people
- The purpose of quality systems and their importance in complying with GMP
- How the GMP regulations relate to facilities and equipment
- How the GMP regulations relate to manufactured products and manufacturing processes
- How the GMP regulations relate to samples and sampling

Assessment Context

The GMP regulations and how they relate to own organisation and the laboratory, to include:-

- The external agencies who are responsible for ensuring compliance with GMP regulations
- How the GMP regulations relate to own organisation and the laboratory
- Why GMP regulations are important in relation to own organisation and laboratory
- How the GMP requirements are monitored within own organisation and laboratory
- What to do when GMP non-compliances are identified
- The consequences of not complying with the GMP regulations
- The terms Quality Assurance, GMP, quality control and quality risk management and the relationship between them

The purpose of documentation and its role in GMP compliance, to include:-

- The types of documentation used within own organisation (Instructions and records) (1)
- How GMP documents are controlled
- The process for amending/updating GMP instructions and records
- The importance of collating information so that trends can be analysed
- The GMP requirement for the archive and retrieval of documentation

(1) Documentation can be electronic or paper. Paper documentation should include but is not limited to: Standard Operating Procedures (SOPs), Standard test procedures and analytical test notes, product specifications, manufacturing instructions and records, protocols and reports. Electronic documentation should include but is not limited to systems that control analytical instruments and collect analytical data.

How the GMP regulations relate to people, to include:-

- A training system
- Individual training plans
- Training methods used to provide individuals with the right skills, experience and knowledge
- The GMP training that individuals need to undertake (initially and on an on-going basis)
- The need to perform assessment of individuals following training interventions to determine that they have sufficient skills and knowledge to complete their tasks to pre-defined standards
- The skills, knowledge and experience that an individual is required to have to fulfil the requirements of specific roles

The purpose of quality systems and their importance in complying with GMP, to include:-

- Quality systems used within own organisation and the laboratory,
- The organisations deviation and CAPA system and the laboratory OOS and CAPA system (1)
- The organisations change control system
- How audits can be used to monitor GMP compliance and help to identify improvements
- How quality systems support GMP and why they are important
- The consequences of not having quality systems or having ineffective quality systems
- Validation

(1) CAPA = Corrective And Preventative Actions, OOS = Out Of Specification

How the GMP regulations relate to facilities and equipment, to include:-

- Good housekeeping
- The validation of facilities and equipment
- Restricting access to GMP areas to authorised personnel only
- Good material and people flow to prevent the possibility of contamination and mix-ups of samples and products
- Regular cleaning and sanitation of Facilities
- Choosing the right equipment
- The requirements for documentation in relation to facilities and equipment
- The consequences of non-compliance with the GMP regulations in relation to facilities and equipment

How the GMP regulations relate to manufactured products and manufacturing processes, to include:-

- How data generated in the laboratories help to provide information about manufacturing processes and products
- The requirements for documentation in relation to manufacturing processes and products
- Good material and people flow to prevent the possibility of contamination and mix-ups of manufactured products
- Product specifications in ensuring the quality of a product
- The role of a technical agreement between the organisation and suppliers
- The requirements for sampling in a manufacturing area
- Taking a representative sample for the laboratory
- The consequences of non-compliance with the GMP regulations in relation to manufactured products and manufacturing processes

How the GMP regulations relate to samples and sampling, to include:-

- Good material and people flow to prevent the possibility of contamination and mix-ups of samples in the laboratory
- The requirements for documentation in relation to sample receipt, sample analysis and sample release
- Product specifications in ensuring the quality of a product
- Taking a representative sample for analysis
- The storage requirements for test samples of a product
- How data generated in the laboratory provides information for compliance against a specification, process validation, equipment validation and stability of product
- The consequences of non-compliance with the GMP regulations relating to samples and sampling

Learning Outcome and Assessment Criteria

Learning outcomes **The learner will:**	**Assessment criteria** **The learner can:**
1. Understand the Good Manufacturing Practice (GMP) Regulations and how they relate to a laboratory	1.1. Describe the external agencies responsible for ensuring compliance with Good Manufacturing Practice (GMP) Regulations 1.2. Explain how Good Manufacturing Practice (GMP) Regulations relate to an organisation and their laboratories and their importance 1.3. Describe how Good Manufacturing Practice (GMP) requirements may be monitored in an organisation and laboratory 1.4. Describe the organisation's procedures for the identification of Good Manufacturing Practice (GMP) non-compliances 1.5. Explain the consequences of not complying with Good Manufacturing Practice (GMP) regulations
2. Know the purpose of documentation and its role in Good Manufacturing Practice (GMP) compliance	2.1. List the types of documentation that may be used within an organisation that practises Good Manufacturing Practice (GMP) 2.2. Describe how Good Manufacturing Practice (GMP) documents are controlled 2.3. Describe how trends can be analysed using collated information and its importance 2.4. Describe the Good Manufacturing Practice (GMP) requirement for archive and retrieval of documentation
3. Understand how Good Manufacturing Practice (GMP) regulations relate to laboratory staff	3.1. Describe the purpose of a training system and individual training plans 3.2. List the various training methods that may be used to provide the skills, experience and knowledge required 3.3. Describe the Good Manufacturing Practice (GMP) training needed initially and on an on-going basis 3.4. Describe the purpose of assessment in a Good Manufacturing Practice (GMP) system
4. Understand the purpose of quality systems and how they should comply with Good Manufacturing Practice (GMP)	4.1. Describe the types of quality systems that may be used within an organisation and how they support Good Manufacturing Practice (GMP) 4.2. Describe the types of quality systems that may be used within a laboratory 4.3. Explain the purpose of audits in monitoring compliance and how they help to identify improvements 4.4. Explain the consequences of not having, or ineffective, quality systems 4.5. Describe the term 'Validation' in relation to Good Manufacturing Practice (GMP)

5. Understand how Good Manufacturing Practice (GMP) Regulations relate to laboratory facilities and equipment	5.1. Describe the term 'good housekeeping' in relation to Good Manufacturing Practice (GMP) 5.2. Explain the purpose of validating facilities and equipment 5.3. Explain the purpose of restricting access to Good Manufacturing Practice (GMP) areas to authorised personnel only 5.4. State how the flow of material and people should prevent the possibility of contamination to laboratory facilities and equipment 5.5. Describe the regime required for regular cleaning and sanitisation of facilities 5.6. Describe the procedure for ensuring that the appropriate equipment is selected 5.7. Describe the requirements for documentation for facilities and equipment 5.8. State the procedures for non-compliances for facilities and equipment and the consequences
6. Understand how Good Manufacturing Practice (GMP) Regulations relate to manufactured products and the manufacturing process	6.1. Describe how data generated in laboratories provides information about the manufacturing processes and products 6.2. List the requirements of documentation used in manufacturing processes and products 6.3. List the content of product specification to ensure the quality of the product 6.4. Describe the purpose of a technical agreement between an organisation and its suppliers 6.5. Describe the typical procedure for sample taking in a manufacturing area 6.6. Explain the consequences of non-compliance with Good Manufacturing Practice (GMP) with regard to manufactured products and manufacturing processes
7. Understand how Good Manufacturing Practice (GMP) Regulations relate to samples and sampling	7.1 State how the flow of material and people should prevent the possibility of contamination and mix-up of samples in a laboratory 7.2 Describe the procedure for sample receipt, analysis and sample release in a laboratory 7.3 Describe the purpose of taking a representative sample for analysis 7.4 Describe the importance of storage requirements for test samples of a product 7.5 Explain the importance of data generated in the laboratory and how it provides information on compliance for all aspects of the manufacturing process 7.6 Describe the consequences of non-compliance with Good Manufacturing Practice (GMP) in relation to samples and sampling

UNIT CLTS3 10	**CHROMATOGRAPHY**
LEVEL	**4**
CREDIT VALUE	**5**
GUIDED LEARNING HOURS	**40**

Unit Overview

This unit addresses the knowledge required to understand the different types of chromatography; including: High Performance Liquid Chromatography (HPLC), Gas Chromatography (GC) and Thin Layer Chromatography (TLC).

This unit will cover knowledge of:

- The different types of chromatography
- The principles and equipment used for High Performance Liquid Chromatography (HPLC)
- The principles and equipment used for Gas Chromatography (GC)
- The principles and equipment used for Thin Layer Chromatography (TLC)

Assessment Context

The different types of chromatography, to include:-

- The most commonly used chromatography techniques (1) for analysis
- Qualitative and quantitative analysis in context of each chromatography technique
- The types of analysis appropriate to each of the most commonly used chromatography techniques
- Health, safety and environmental regulations in context of the most commonly used chromatographic techniques
- How to solve problems associated with the most commonly used chromatography techniques
- The advantages, disadvantages and limitations of each of the commonly used Chromatography techniques used for analysis
- Mobile phases and stationary phases
- The chromatographic process for separating compounds

(1) Most common chromatography techniques are HPLC, GC and TLC and must be covered as a minimum. Other techniques could include: paper Chromatography, ion chromatography or column chromatography.

The principles and equipment used for High Performance Liquid Chromatography (HPLC), to include:-

- The component parts of an HPLC system
- Reverse phase and normal phase HPLC
- System suitability requirements for HPLC
- The different types of pump that can be used for HPLC
- The different types of detectors used in HPLC
- The types of column used for HPLC analysis
- The effects of changing, pump flow rate, injection volume, oven temperature can have on the chromatography produced
- Calibration and maintenance requirements for an HPLC system and the importance of keeping appropriate records
- Health, safety and environmental regulations as they apply to HPLC

The principles and equipment used for Gas Chromatography (GC), to include:-

- The component parts of a GC system
- The types of gas used for GC (1)
- System suitability requirements for GC
- The different types of injector that can be used for GC
- The different types of detectors used in GC
- The types of column used for GC analysis and the effects that column width, length and type of phase, can have on the chromatography

- The effects of changing, carrier gas flow rate, injection volume, injector temperature/temperature profile, oven temperature/temperature profile can have on the chromatography produced
- Calibration and maintenance requirements for a GC system and the importance of keeping appropriate records
- Health, safety and environmental regulations as they apply to GC

(2) Carrier gasses (Mobile phase) – Helium & Nitrogen, FID detector gases – Hydrogen, air, nitrogen, helium

The principles and equipment used for Thin Layer Chromatography, to include:-

- The components used for TLC
- The different types of plate that can be used for TLC
- The different types of detection methods used for visualising the separated components on a plate
- The types of mobile phase used and the conditioning of the development chamber
- Rf values and how they are used in TLC
- How to document the developed chromatogram and why it is important
- Health, safety and environmental regulations as they apply to TLC

Learning Outcome and Assessment Criteria

Learning outcomes **The learner will:**	**Assessment criteria** **The learner can:**
1. Understand the different types of chromatography	1.1. List the most commonly used chromatography techniques for analysis 1.2. Describe the terms qualitative and quantitative analysis for the most commonly used chromatography techniques 1.3. Describe the types of analysis appropriate for the most commonly used chromatographic techniques 1.4. Explain how to solve the problems associated with the most commonly used chromatographic techniques 1.5. Describe the advantages, disadvantages and limitations for the most commonly used chromatographic techniques 1.6. Describe the terms 'Mobile' and 'Stationary' phases 1.7. Describe the chromatographic process for separating compounds
2. Understand the principles and equipment used for High Performance Liquid Chromatography (HPLC)	2.1. Describe the component parts of a High Performance Liquid Chromatography (HPLC) system 2.2. Explain reverse phase and normal phase in terms of High Performance Liquid Chromatography (HPLC) 2.3. Describe the system suitability requirements for High Performance Liquid Chromatography (HPLC) 2.4. List the different types of pump that can be used for High Performance Liquid Chromatography (HPLC) 2.5. List the different types of detectors used in High Performance Liquid Chromatography (HPLC) 2.6. Describe the types of column used for High Performance Liquid Chromatography (HPLC) analysis 2.7. Describe the effects that variations may have on the chromatography produced 2.8. Describe the calibration and maintenance requirements for a High Performance Liquid Chromatography (HPLC) system and the importance of keeping appropriate records 2.9. Describe the Health, Safety and Environmental regulations as they apply to High Performance Liquid Chromatography (HPLC)
3. Understand the principles and equipment used for Gas Chromatography (GC)	3.1. List the component parts of a Gas Chromatography (GC) system 3.2. List the types of gas used for Gas Chromatography (GC) 3.3. Describe the system suitability requirements for Gas Chromatography (GC) 3.4. Describe the different types of injector that can be used for Gas Chromatography (GC) 3.5. List the different types of detectors used in Gas Chromatography (GC)

	3.6. Describe the types of column used for Gas Chromatography (GC) analysis and the effects that column width, length and type of phase, can have on the chromatography 3.7. Describe the effects that variations in chromatographic parameters may have on the chromatography produced 3.8. Describe the calibration and maintenance requirements for a Gas Chromatography (GC) system and the importance of keeping appropriate records 3.9. Describe the Health, Safety and Environmental regulations as they apply to Gas Chromatography (GC)
4. Understand the principles and equipment used for Thin Layer Chromatography (TLC)	4.1. List the components used for Thin Layer Chromatography (TLC) 4.2. Describe the different types of plate that can be used for Thin Layer Chromatography (TLC) 4.3. Describe the different types of detection methods used for visualising the separated components on a plate 4.4. Explain the types of mobile phase used and the conditioning of the development chamber 4.5. Describe the term Rf values and how they are used in Thin Layer Chromatography (TLC) 4.6. Describe how to document the developed chromatogram and why it is important 4.7. Describe the Health, Safety and Environmental regulations as they apply to Thin Layer Chromatography (TLC)