

**REPUBLIC OF KENYA**

**COMPETENCY-BASED MODULAR CURRICULUM**

**FOR**

**SCIENCE LABORATORY TECHNOLOGY**

**KNQF LEVEL 5**

**PROGRAMME ISCED CODE:****0711 454A**

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# FOREWORD

The provision of quality education and training is fundamental to the Government’s overall strategy for social and economic development. Quality education and training contribute to the achievement of Kenya’s development blueprint and sustainable development goals.

Reforms in the education sector are necessary to achieve Kenya Vision 2030 and meet the provisions of the Constitution of Kenya 2010. The education sector had to be aligned to the Constitution, and this resulted in the formulation of the Policy Framework for Reforming Education and Training in Kenya (Sessional Paper No. 14 of 2012). A key feature of this policy is the radical change in the design and delivery of TVET training. This policy document requires that training in TVET be competency-based, curriculum development be industry-led, certification be based on demonstration of competence, and the mode of delivery allow for multiple entry and exit in TVET programmes.

These reforms demand that Industry takes a leading role in curriculum development to ensure the curriculum addresses its competence needs. It is against this background that this curriculum has been developed. For trainees to build their skills on foundational hands-on activities of the occupation, units of learning are grouped in modules. This has eliminated duplication of content and streamlined exemptions based on skills acquired as a trainee progresses in the up-skilling process, while at the same time allowing trainees to be employable in the shortest time possible through the acquisition of part qualifications.

It is my conviction that this curriculum will play a great role in developing competent human resources for the Science Laboratory Technology Sector’s growth and development.

**PRINCIPAL SECRETARY**

**STATE DEPARTMENT FOR TVET**

**MINISTRY OF EDUCATION**

**PREFACE**

Kenya Vision 2030 aims to transform Kenya into a newly industrializing middle-income country, providing high-quality life to all its citizens by the year 2030. Kenya intends to create globally competitive and adaptive human resource base to meet the requirements of a rapidly industrializing economy through lifelong education and training. TVET has a responsibility to facilitate the process of inculcating knowledge, skills, and worker behaviour necessary for catapulting the nation to a globally competitive country, hence the paradigm shift to embrace Competency-Based Education and Training (CBET).

CAP 210A and Sessional Paper No. 1 of 2019 on Reforming Education and Training in Kenya for Sustainable Development emphasized the need to reform curriculum development, assessment, and certification. This called for a shift to CBET to address the mismatch between skills acquired through training and skills needed by industry, as well as increase the global competitiveness of the Kenyan labour force.

This curriculum has been developed in adherence to the Kenya National Qualifications Framework and CBETA standards and guidelines. The curriculum is designed and organized into Units of Learning with Learning Outcomes, suggested delivery methods, learning resources, and methods of assessing the trainee’s achievement. In addition, the units of learning have been grouped in modules to concretize the skills acquisition process and streamline upskilling.

I am grateful to all expert trainers and everyone who played a role in translating the Occupational Standards into this competency-based modular curriculum.

**CHAIRMAN OF THE COUNCIL**

# ACKNOWLEDGMENT

This curriculum has been designed for competency-based training and has independent units of learning that allow the trainee flexibility in entry and exit. In developing the curriculum, significant involvement and support were received from expert trainers, institutions and organizations.

I recognize with appreciation the role of the Science Laboratory National Sector Skills Committee (NSCC) in ensuring that competencies required by the industry are addressed in the curriculum. I also thank all stakeholders in the science laboratory technology sector for their valuable input and everyone who participated in developing this curriculum.

I am convinced that this curriculum will go a long way in ensuring that individuals aspiring to work in the science laboratory technology sector acquire competencies to perform their work more efficiently and effectively.

**COUNCIL SECRETARY**

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# ACRONYMS

CBET : Competency-Based Education and Training

ICT : Information communication technology

KNQF : Kenya National Qualification Framework

PPEs : Personal Protective Equipment

SOPs : Standard Operating Procedures

TVET : Technical and Vocational Education and Training

TVETA : Technical and Vocational Education and Training Authority

**KEY TO UNIT CODE**

**Sector / Industry**

**Sub Sector**

**Occupational Area**

**Version Control**

**Unit of Competence Number**

**ISCED level, Programme Orientation and Level of Completion**

xx

x

xxx

x

x

x

# COURSE OVERVIEW

Science Laboratory Technology Level 5 qualification consists of competencies that an individual must possess to become a Science Laboratory Technician. It involves integrating standard laboratory practices, biology techniques, laboratory equipment maintenance, chemistry techniques and physics techniques.

**Summary of Units of Learning**

|  |  |  |  |
| --- | --- | --- | --- |
| **UNIT CODE** | **UNIT TITLE** | **UNIT DURATION (HOURS)** | **CREDIT FACTOR** |
| **MODULE I** | | | |
| 0031 541 01A | COMMUNICATION SKILLS | 40 | 4 |
| 0588 441 02A | GENERAL SCIENCE SKILLS | 80 | 8 |
| 1022 441 03A | SCIENCE LABORATORY PRACTICE | 180 | 18 |
| 0511 441 04A | BIOLOGY TECHNIQUES | 180 | 18 |
| **SUB TOTAL** | | **480** | **48** |
| **MODULE II** | | | |
| 0413 441 05A | DIGITAL LITERACY | 40 | 4 |
| 0541 441 06A | BASIC MATHEMATICS FOR SCIENCE | 120 | 12 |
| 1022 541 07A | LABORATORY EQUIPMENT MAINTENANCE | 80 | 8 |
| 0531 441 08A | CHEMISTRY TECHNIQUES | 180 | 18 |
| **SUB TOTAL** | | **420** | **42** |
| **MODULE III** | | | |
| 0417 441 09A | WORK ETHICS AND PRACTICES | 40 | 4 |
| 0413 441 10A | ENTREPRENEURIAL SKILLS | 40 | 4 |
| 0588 441 11A | SCIENCE LABORATORY RESEARCH | 100 | 10 |
| 0533 441 12A | PHYSICS TECHNIQUES | 180 | 18 |
| **SUB TOTAL** | | **360** | **36** |
|  | **INDUSTRIAL TRAINING** | **480** | **48** |
| **GRAND TOTAL** | | **1740** | **174** |

**Entry Requirements**

**Science Laboratory Technology Level 5**

An individual enrolling for this course should have the following minimum requirement:

1. A Kenya Certificate of Secondary Education (KCSE) mean grade D (plain) or KCE Division III.
2. A qualification equivalent to KCSE minimum Grade D(plain) as determined by TVETA.

**Trainer Qualification**

1. Must have a minimum of a KNQF level 6 qualification in Science Laboratory Technology or its equivalent.
2. Be registered by TVETA.

**Industry Training**

An individual enrolled in this course will be required to undergo Industry training for a minimum period of 480 hours in Science Laboratory and Research sector. The industrial training may be taken after completion of all units for those pursuing the full qualification or be distributed equally in each unit for those pursuing part qualification. In the case of dual training model, industrial training shall be as guided by the dual training policy.

**Assessment**

**The course shall be assessed formatively and summatively:**

1. During formative assessment all performance criteria shall be assessed based on performance criteria weighting.
2. Number of formative assessments shall minimally be equal to the number of elements in a unit of competency.
3. During summative assessment basic and common units may be integrated in the core units or assessed as discrete units.
4. Theoretical and practical weight shall be 30:70 for each unit of learning.
5. Formative and summative assessments shall be weighted at 60% and 40% respectively in the overall unit of learning score

**For a candidate to be declared competent in a unit of competency, the candidate must meet the following conditions:**

1. Obtained at least 40% in theory assessment in formative and summative assessments.
2. Obtained at least 60% in practical assessment in formative and summative assessment where applicable.
3. Obtained at least 50% in the weighted results between formative assessment and summative assessment where the former constitutes 60% and the latter 40% of the overall score.
4. Assessment performance rating for each unit of competency shall be as follows:

|  |  |
| --- | --- |
| **MARKS** | **COMPETENCE RATING** |
| 80 -100 | Attained Mastery |
| 65 - 79 | Proficient |
| 50 - 64 | Competent |
| 49 and below | Not Yet Competent |
| Y | Assessment Malpractice/irregularities |

1. Assessment for Recognition of Prior Learning (RPL) may lead to award of part and/or full qualification.

**Certification**

A candidate will be issued with a Certificate of Competency upon demonstration of competence in a core Unit of Competency. To be issued with Kenya National TVET Certificate in Science Laboratory Technician Level 5, the candidate must demonstrate competence in all the Units of Competency as given in the qualification pack. A Statement of Attainment certificate may be awarded upon demonstration of competence in certifiable element within a unit.

These certificates will be issued by Qualification Awarding Institution

# MODULE I UNITS OF LEARNING

# MODULE SUMMARY

The table presented below outlines the units and credit factors included in this module.

|  |  |  |  |
| --- | --- | --- | --- |
| **UNIT CODE** | **UNIT NAME** | **ELEMENTS** | **DURATION (HOURS)** |
| 0031 441 01A | COMMUNICATION SKILLS | Apply communication channels. | 10 |
| Apply written communication skills. | 12 |
| Apply non-verbal skills. | 4 |
| Apply oral communication skills. | 4 |
| Apply group communication skills | 10 |
| **Total** | **40** |
| 1022 441 02A | SCIENCE LABORATORY PRACTICE | Perform laboratory safety procedure | 60 |
| Maintain laboratory resources | 60 |
| Prepare laboratory reagents and chemicals | 60 |
| **Total** | **180** |
| 0588 441 03A | GENERAL SCIENCE SKILLS | Apply animal anatomy and physiology concepts | 20 |
| Apply plant anatomy and physiology concepts | 20 |
| Apply inorganic chemistry concepts | 10 |
| Apply organic chemistry concepts | 10 |
| Apply physical chemistry concepts | 10 |
| Apply mechanics concept | 10 |
|  |  | **Total** | **80** |
| 0511 441 04A | BIOLOGY TECHNIQUES | Perform cytological test | 20 |
| Perform food test | 20 |
| Carry out microbiological techniques | 50 |
| Care for laboratory animals | 20 |
| Carry out herbarium techniques | 20 |
| Cary out museum techniques | 20 |
| Conduct ecological experiments | 30 |
| **Total** | **180** |
|  |  | **SUB TOTAL** | **480** |

# COMMUNICATION SKILLS

**UNIT CODE:** **0031 441 01A**

**Relationship to Occupational Standards**

This unit addresses the Unit of Competency: Apply Communication Skills

**Duration of Unit:** 40 hours

**Unit Description**

This unit encompasses the skills necessary for effective communication. It includes the utilization of various communication methods, such as written, non-verbal, oral, and group communication techniques.

**Summary of Learning Outcomes**

By the end of this unit, the learner should be able to:

|  |  |  |
| --- | --- | --- |
| **S/No** | **Learning Outcomes** | **Duration (Hours)** |
| 1. | Apply communication channels. | 10 |
| 2. | Apply written communication skills. | 12 |
| 3. | Apply non-verbal skills. | 4 |
| 4. | Apply oral communication skills. | 4 |
| 5 | Apply group communication skills. | 10 |
| **Total** | | **40** |

**Learning Outcomes, Content, and Suggested Assessment Methods**

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Apply communication channels | 1. Communication process 2. Principles of effective communication 3. Channels/medium/modes of communication 4. Factors to consider when selecting a channel of communication 5. Barriers to effective communication 6. Flow/patterns of communication 7. Sources of information 8. Organizational policies | * Practical assessment * Observation * Portfolio of Evidence * Oral questions * Written assessment * Third party report |
| 1. Apply written communication skills | * 1. Types of written communication   2. Elements of communication   3. Organization requirements for written communication | * Practical assessment * Observation * Portfolio of Evidence * Oral questions * Written assessment * Third party report |
| 1. Apply non-verbal communication skills | * 1. Utilize body language and Gestures   2. Apply body posture   3. Apply workplace dressing code | * Practical assessment * Observation * Portfolio of Evidence * Oral questions * Written assessment * Third party report |
| 1. Apply oral communication skills | * 1. Types of oral communication pathways   2. Effective questioning techniques   3. Workplace etiquette   4. Active listening | * Practical assessment * Observation * Portfolio of Evidence * Oral questions * Written assessment * Third party report |
| 1. Apply group discussion skills | * 1. Establishing rapport   2. Facilitating resolution of issues   3. Developing action plans   4. Group organization techniques   5. Turn-taking techniques   6. Conflict resolution techniques   7. Team-work | * Practical assessment * Observation * Portfolio of Evidence * Oral questions * Written assessment * Third party report |

**Suggested Methods of Instruction**

* Discussion
* Roleplaying
* Simulation
* Direct instruction
* Demonstration
* Field trips

**Recommended Resources for 25 trainees**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S/no.** | **Category/item** | **Description/specification** | **Quantity** | **Recommended ratio(item: trainee)** |
| 1. **Learning materials** | | | | |
|  | Case studies | Published case studies | 5 | 1:5 |
|  | Business plan templates | Standard business plan templates | 5 | 1:5 |
|  | Video clips | Digital types | 25 | 1:25 |
|  | Newspapers and Handouts | Well reputed news papers | 5 | 1:5 |
|  | Business Journals | Well reputed journals | 5 | 1:5 |
| 1. **Learning facilities and infrastructure** | | | | |
|  | Lecture/theory room | 72m2 | 1 | 1:25 |
|  | Whiteboard | 4 feet by 8 feet | 1 | 1:25 |
|  | Projector | LCD High resolution | 1 | 1:25 |
|  | Computers | RAM: 8GB | 25 | 1:25 |
|  | Printers | Ink Jet | 2 | 1:13 |
|  | Smart TV | LCD | 1 | 1:25 |
|  | Internet connection | Adequate speed |  | 1:25 |
| 1. **Consumable materials** | | | | |
|  | Stationary materials | Pens, pencils, papers | Enough for 25 | 1:25 |
|  | Assorted whiteboard markers | Non-permanent | Enough for 25 | 1:25 |

## SCIENCE LABORATORY PRACTICE

**UNIT CODE: 1022 441 02A**

**UNIT DURATION:**  180 Hours

**Relationship to Occupational Standards**

This unit addresses the Unit of Competency: Perform Science Laboratory Practice

**Unit Description**

This unit specifies the competencies required to perform standard laboratory practices. It involves performing laboratory safety procedures, maintaining laboratory resources and preparing laboratory reagents and chemicals.

**Summary of Learning Outcomes**

By the end of this unit, the learner should be able to:

|  |  |  |
| --- | --- | --- |
| **S/No** | **Learning Outcomes** | **Duration (Hours)** |
| 1. | Perform laboratory safety procedure | 60 |
| 2. | Maintain laboratory resources | 60 |
| 3. | Prepare laboratory reagents and chemicals | 60 |
| **Total** | | **180** |

**Learning Outcomes, Content and Suggested Assessment Methods**

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Perform laboratory safety procedure | 1. Science laboratory PPEs    * 1. Lab coats      2. Gloves      3. Overalls      4. Goggles      5. Muffs      6. Face shields      7. Helmets      8. Hair nets      9. Respirators      10. Masks 2. Laboratory hazards and risks    * 1. Chemical      2. Biological      3. Electrical      4. Radioactive      5. Musculoskeletal stresses      6. Electrical      7. Physical 3. Handling and storage of laboratory chemicals and reagents    * 1. Acids      2. Bases      3. Salts      4. Indicators      5. Distilled water 4. Laboratory waste disposal    * 1. Sharp objects      2. Glassware      3. Biological samples      4. General lab waste      5. Wipes      6. Gloves      7. Tissues      8. Chemicals      9. Radioactive materials      10. Electrical materials 5. Laboratory safety rules 6. Risk assessment in the laboratory 7. Types of laboratory related Injuries and their treatment 8. First aid procedures. 9. Development of emergency response procedures and preparedness. 10. Maintenance of records of hazards, risk assessment and control measures | * Practical * Project * Third party report * Portfolio of evidence * Written test * Oral test |
| 1. Maintain laboratory resources | * 1. Laboratory inventory maintenance   2. Maintain laboratory equipment and apparatus      1. Calibration      2. Cleaning      3. Dusting      4. Painting.   3. Storage of laboratory resources   4. Disposal of obsolete laboratory resources | * Practical * Project * Third party report * Portfolio of evidence * Written test * Oral test |
| 3. Prepare laboratory reagents and chemicals | * 1. Assembly of laboratory equipment      1. Bunsen burner      2. Microscopes      3. Hot plates      4. Magnetic stirrer      5. Water baths      6. Oven      7. Freezers      8. Furnace   3.2 Assembly of laboratory of laboratory apparatus   * + 1. Balances     2. Wash bottles     3. Glass ware     4. Crucibles     5. Brushes     6. Filter papers     7. Pestle and mortar   1. Preparation of laboratory reagents and chemicals      1. Acids      2. Bases      3. Salts      4. Indicators      5. Distilled water   2. Storage of laboratory reagents and chemicals | * Practical * Project * Third party report * Portfolio of evidence * Written test * Oral test |

**Suggested Methods of Instruction**

* Demonstration
* Viewing of related videos
* Discussion
* Direct Instruction

**Recommended Resources for 25 Trainees**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S/No.** | **Category/Item** | **Description/ Specifications** | **Quantity** | **Recommended Ratio**  **(Item: Trainee)** |
| **A** | **Learning Materials** | | | |
|  | Computer | For trainer’s use | 1 | 1:25 |
|  | Projector | For trainer’s use | 1 | 1:25 |
|  | Standard manuals/SOPs | For trainer’s use | **1** | 1:25 |
|  | Flip charts | For trainer’s use | **1** | 1:25 |
|  | White /black board | For trainer’s use | **1** | 1:25 |
| **B** | **Learning Facilities & infrastructure** | | | |
|  | Lecture room | For trainee use | 1 | 1:25 |
|  | Standard science laboratory | For trainee use | 1 | 1:25 |
|  | Lecture room | For trainee use | **1** | 1:25 |
| **C** | **Consumable materials** | | | |
|  | Stationeries | For trainee use | **25** | 1:1 |
|  | Gloves | For trainee use | **25** | 1:1 |
|  | Laboratory coats | For trainee use | **25** | 1:1 |
|  | Goggles | For trainee use | **25** | 1:1 |
|  | Face masks | For trainee use | **25** | 1:1 |
| **D** | **Apparatus and Equipment** | | | |
|  | Compound light microscope | For trainee use | **5** | 1:5 |
|  | Safety boot | For trainee use | **25 pairs** | 1:1 |
|  | Laboratory coats | For trainee use | **25** | 1:1 |

## GENERAL SCIENCE SKILLS

**UNIT CODE: 0588 441 03A**

**UNIT DURATION:**  80 Hours

**Relationship to Occupational Standards**

This unit addresses the Unit of Competency: Apply general science principles

**Unit Description**

This unit covers the competencies required to apply general science principles. It involves applying animal anatomy and physiology concepts, plant anatomy and physiology concepts, inorganic chemistry concepts, organic chemistry concepts, physical chemistry concepts, mechanics concepts and thermodynamics concepts.

**Summary of learning outcomes**

By the end of this unit, the learner should be able to:

|  |  |  |
| --- | --- | --- |
| **S/No** | **Learning Outcomes** | **Duration (Hours)** |
| 1. | Apply animal anatomy and physiology concepts | 20 |
| 2. | Apply plant anatomy and physiology concepts | 20 |
| 3. | Apply inorganic chemistry concepts | 10 |
| 4 | Apply organic chemistry concepts | 10 |
| 5 | Apply physical chemistry concepts | 10 |
| 6 | Apply mechanics concept | 10 |
|  | **Total** | **80** |

**Learning Outcomes, Content and Suggested Assessment Methods**

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Apply animal anatomy and physiology concepts | * 1. Animal nutrition      1. Parasitism      2. Symbiosis      3. Saprophytism      4. Holozoic nutrition   2. Animal transport system      1. Types of circulation      2. Components of the human circulatory system   3. Animal reproduction      1. Organs of the human reproductive system   4. Animal excretory system      1. Organs of the human excretory system      2. Animal gaseous exchange system   5. Organs of gaseous exchange in an insect | * Practical tests * Written tests * Observation * Portfolio of evidence * Third party report |
| 1. Apply plant anatomy and physiology concepts | * 1. Plant nutrition      1. Autotropism- process of photosynthesis   2. plant transport system      1. structure of xylem tissues      2. structure of phloem tissue   3. Plant reproduction      1. Sexual reproduction      2. Asexual reproduction   4. Plant excretory system      1. Plant excretory products   5. Economic importance of plant excretory products   6. Plant gaseous exchange system      1. Mechanism of opening and closing of stomata | * Practical tests * Written tests * Observation * Portfolio of evidence * Third party report |
| 1. Apply mechanics concept | * 1. Friction      1. Definition      2. Applications   2. Newton’s Law of Motion      1. Circular motion      2. Angular displacement      3. Angular velocity      4. Angular acceleration      5. Tension      6. Definition      7. Applications   3. Shear   4. Bulk modulus | * Practical tests * Written tests * Observation * Portfolio of evidence * Third party report |
| 1. Apply thermodynamics concepts | * 1. Modes of heat transfer      1. Conduction      2. Convection      3. Radiation   2. Thermodynamic laws      1. First law of thermodynamics      2. Second law of thermodynamics   3. Work, energy and power   4. Definition   5. Application | * Practical tests * Written tests * Observation * Portfolio of evidence * Third party report |
| 1. Apply inorganic chemistry concepts | * 1. Apply Elements classification knowledge  1. S- block elements 2. P-block elements 3. D- block elements 4. Model Chemical bonds 5. Ionic bond 6. Covalent bond 7. Metallic bond 8. Dative bond 9. Hydrogen bonding 10. Prepare Inorganic salt | * Practical tests * Written tests * Observation * Portfolio of evidence * Third party report |
| 1. Apply organic chemistry concepts | * 1. Apply Organic compound classification knowledge  1. Ionic bond 2. Covalent bond 3. Metallic bond 4. Dative bond 5. Hydrogen bonding    1. Model Organic compound    2. Apply Organic reaction concept       1. Ionic bond       2. Covalent bond       3. Metallic bond       4. Dative bond    3. Hydrogen bonding | * Practical tests * Written tests * Observation * Portfolio of evidence * Third party report |
| 1. Apply physical chemistry concepts | * 1. Identify Acids and bases   2. Acids      1. Hydrochloric acid      2. Sulphuric (VI) acid      3. Nitric (V) acid   3. Bases      1. Sodium hydroxide      2. Ammonia solution      3. Calcium hydroxide   4. Apply Gas law concept      1. Boyle’s Law      2. Charle’s Law      3. Daltons Law of partial pressures      4. Grahams Law of diffusion   5. Apply Electrochemistry concept.      1. Reduction      2. Oxidation      3. Electrolysis      4. Faraday’s Laws 1 and 2   6. Electrolytes | * Practical tests * Written tests * Observation * Portfolio of evidence * Third party report |

**Suggested Methods of Instruction**

* Demonstration
* Viewing of related videos
* Discussion
* Direct Instruction
* Field study

**Recommended Resources for 25 Trainees**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S/No.** | **Category/Item** | **Description/ Specifications** | **Quantity** | **Recommended Ratio**  (Item: Trainee) |
| **A** | **Learning Materials** | | | |
| 1. | Desktop computer/laptop | For trainer’s use | 1 | 1:25 |
|  | Internet connection | Wi-Fi |  | 1:25 |
|  | Projector |  | 1 | 1:25 |
|  | Whiteboard | 4 x 8 ft | 1 | 1:25 |
|  | Assorted colour of whiteboard markers | Red, blue and black | 3 | 1:25 |
|  | thermometers | Liquid in glass thermometer | 25 | 1:1 |
|  | stopwatches | Digital | 25 | 1:1 |
|  | weighing balances | Electronic balance  (0-2kg) | 5 | 1:5 |
|  | calorimeters | Copper calorimeters | 25 | 1:1 |
|  | Solid block | wooden | 25 | 1:1 |
|  | Ball bearing | One packet | 25 | 1:1 |
|  | Rollers | One packet | 25 | 1:1 |
|  | Spring | 2N/cm | 25 | 1:1 |
|  | Rubber band | Standard | 25 | 1:1 |
|  | Portable burner | 300g | 25 | 1:1 |
|  | Source of water | Taps/sinks | 10 | 2:5 |
|  | Electric sockets | Single sockets | 10 | 2:5 |
|  | pulley | single |  | 1:1 |
|  | Inclined plain | 4 |  | 1:25 |
|  |  |  |  |  |
| **B** | **Learning Facilities & infrastructure** | | | |
| 1 | standard Science laboratory |  | 1 | 1:25 |
| **2** | Ovens | For trainer’s and trainee use | 1 | 1:25 |
| **3** | Furnace | For trainer’s and trainee use | 1 | 1:25 |
| **4** | Colorimeter | For trainer’s and trainee use | 1 | 1:25 |
| **5** | Flame emission spectrophotometer | For trainer’s and trainee use | 1 | 1:25 |
| **6** | Furnace | For trainer’s and trainee use | 1 | 1:25 |
| **7** | Analytical Balance | For trainer’s and trainee use | 5 | 1:5 |
| **8** | Soxhlet extractor | For trainer’s and trainee use | 4 | 1:8 |
| **9** | Khjedhal Apparatus | For trainer’s and trainee use | 3 | 1:8 |
| **10** | Microscopes | For trainer’s and trainee use | 5 | 1:5 |

## BIOLOGICAL TECHNIQUES

**UNIT CODE: 0511 441 04A**

**UNIT DURATION:**  180 Hours

**Relationship to Occupational Standards**

This unit addresses the Unit of Competency: Perform Biology Techniques

**Unit Description**

This unit specifies the competencies required to Perform Biology Techniques. It involves performing cytological test, performing food test, Care for laboratory animals and carrying out microbiological techniques. It also entails carrying out herbarium techniques, carrying out museum techniques and conducting ecological experiments.

**Summary of Learning Outcomes**

By the end of this unit, the learner should be able to:

|  |  |  |
| --- | --- | --- |
| **S/No** | **Learning Outcomes** | **Duration (Hours)** |
| 1. | Perform cytological test | 20 |
| 2. | Perform food test | 20 |
| 3. | Carry out microbiological techniques | 50 |
| 4 | Care for laboratory animals | 20 |
| 5 | Carry out herbarium techniques | 20 |
| 6 | Cary out museum techniques | 20 |
| 7 | Conduct ecological experiments | 30 |
|  | **Total** | **180** |

**Learning Outcomes, Content and Suggested Assessment Methods**

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| * + - 1. Perform cytological test | * 1. Identification of plant and animal cells and tissues and their structures.   2. Isolation and staining of plant and animal cells.   3. Microscopy and micrometry.   4. Types of microscopes  1. Florescent microscope 2. Bright field microscope 3. Dark ground microscope 4. Electron microscope 5. Phase contrast microscope 6. Dissecting microscope    1. Movement of substances in and out of the cell:       1. Exocytosis       2. Endocytosis    2. Preparation of solutions of various concentrations to demonstrate diffusion and osmosis    3. Active transport:       1. Primary active transport       2. Secondary active transport    4. Cell division       1. Mitosis       2. meiosis | * Practical test * Portfolio of evidence * Written tests * Third party report * Oral questioning |
| * + - 1. Perform food test | * 1. Apparatus used for food test.   2. Preparation of reagents used for food test      1. Test for reducing sugars      2. Test for non-reducing sugars      3. Test for proteins      4. Test for starch      5. Test for vitamin C (Ascorbic acid)      6. Test for lipids   3. Laboratory practical report writing. | 1. Practical test 2. Portfolio of evidence 3. Written tests 4. Third party report 5. Oral questioning |
| * + - 1. Carry out microbiological techniques | * 1. Types of microorganisms:      1. Bacteria      2. Fungi      3. Protozoa      4. Viruses   2. Aseptic techniques   3. Sterilization techniques      1. Dry heat      2. Wet heat      3. Radiation.   4. Preparation of culture media:      1. Agar      2. Broth   5. Types of culture media      1. Basal media      2. Enriched media      3. Selective media      4. Enrichment media      5. Transport media      6. Storage media   6. Culture of microorganisms   7. Preparation and observation of bacterial smears   8. Disposal of pathogenic materials. | * Practical test * Portfolio of evidence * Written tests * Third party report * Oral questioning |
| * + - 1. Care for laboratory animals | * 1. Types of laboratory animals.      1. Rats      2. Guinea pigs      3. Rabbits      4. Mongolian gerbil      5. Hamsters      6. Insects      7. Birds   2. Housing, feeding and handling of laboratory animals   3. Humane killing of laboratory animals:      1. Physical methods      2. Chemical methods      3. Electrical methods   4. Dissection of laboratory animals   5. Diseases and pests’ control in an animal house.      1. Bacterial diseases      2. Fungal diseases      3. Viral diseases      4. Protozoan diseases   6. Methods of disposal of carcasses.      1. Incineration.      2. Burying.      3. Preservation. | 1. Practical test 2. Portfolio of evidence 3. Written tests 4. Third party report 5. Oral questioning |
| * + - 1. Carry out herbarium technique | * 1. Tools for plant specimen collection:      1. Cutting tools      2. Digging tools      3. Collection bags      4. Field stationery      5. Plant press      6. Blotting papers   2. Methods of collecting of plant specimens.      1. Weeding      2. Pruning      3. Irrigation   3. Pest control      1. Planting   4. Types of herbarium specimen.      1. Leaves      2. Roots      3. Flowers      4. Fruits      5. Whole plants      6. Seeds      7. Stems   5. Preservation of plant specimens   6. Labelling, Storage and display of plant specimens | 1. Practical test 2. Portfolio of evidence 3. Written tests 4. Third party report 5. Oral questioning |
| 1. Carry out museum technique | * 1. Collection of museum specimen.   2. Tools used for museum specimen collection.  1. Museum jars 2. Killing jars 3. Pouter 4. Nets 5. Traps 6. Field stationeries 7. Collection bags 8. Pair of tongs and forceps    1. Types of museum specimen. 9. Arthropods 10. Mammals 11. Reptiles 12. Birds 13. Plants 14. Fish 15. Annelids     1. Preservation of animal specimen.     2. Labelling, Storage and display of animal specimen. | * Practical test * Portfolio of evidence * Written tests * Third party report * Oral questioning |
| 1. Conduct ecological experiments | * 1. Terminologies used in ecology  1. Species 2. Habitat 3. Population 4. Community 5. Niche 6. Ecosystem 7. Biome 8. Biosphere 9. Energy transfer in ecosystem    1. Ecological equipment 10. Quadrats 11. Nets 12. Tape measure 13. Ropes and strings 14. Marker pens 15. Instruments of measuring elements of weather     1. Use and care of ecological equipment     2. Identification of Biotic factors     3. Ecological interactions        1. Symbiosis        2. Competition        3. Parasitism        4. Commensalism        5. Predation     4. Identification of Abiotic factors.     5. Population estimation methods. | 1. Practical test 2. Portfolio of evidence 3. Written tests 4. Third party report 5. Oral questioning |

**Suggested Methods of Instruction**

* Demonstration
* Viewing of related videos
* Discussion
* Direct Instruction
* Field excursion

**Recommended Resources for 25 Trainees**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S/No.** | **Category/Item** | **Description/ Specifications** | **Quantity** | **Recommended Ratio**  **(Item: Trainee)** |
| **A** | **Learning Materials** | | | |
|  | Power point presentations | For trainer’s use | 1 | 1:25 |
|  | Computer | For trainer’s use | 1 | 1:25 |
|  | Projector | For trainer’s use | 1 | 1:25 |
|  | Standard manuals/SOPs | For trainer’s use | **1** | 1:25 |
|  | Flip charts | For trainer’s use | **1** | 1:25 |
| **B** | **Learning Facilities & infrastructure** | | | |
|  | **Lecture/theory room** |  |  |  |
|  | Fully equipped science laboratory | For trainee use | **1** | 1:25 |
|  | Lecture room | For trainee use | **1** | 1:25 |
| **C** | **Consumable materials** | | | |
|  | Stationeries | For trainee use | **25** | 1:1 |
|  | Gloves | For trainee use | **25** | 1:1 |
|  | Laboratory coats | For trainee use | **25** | 1:1 |
|  | Masks | For trainee use | **25** | 1:1 |
|  | laboratory animals (rats) | For trainee use | **5** | 1:5 |
|  | Dissecting kit | For trainee use | **5** | 1:5 |
|  | Dissecting board | For trainee use | **5** | 1:5 |
|  | Covers slips | For trainee use | **5** | 1:5 |
|  | Glass slides | For trainee use | **5** | 1:5 |
| **D** | **Tools and Equipment** | | | |
|  | Compound light microscope | For trainee use | **5** | 1:5 |

# MODULE II UNITS OF LEARNING.

# MODULE SUMMARY

The table presented below outlines the units and credit factors included in this module.

|  |  |  |  |
| --- | --- | --- | --- |
| **UNIT CODE** | **UNIT NAME** | **ELEMENTS** | **DURATION (HOURS)** |
| 0611 451 05A | DIGITAL LITERACY | Operate computer devices | 10 |
| Solve tasks using office suite | 5 |
| Manage data and information | 5 |
| Perform online communication and collaboration | 5 |
| Apply cybersecurity skills | 5 |
| Perform online jobs | 5 |
| Apply job entry techniques | 5 |
|  |  | **Total** | **40** |
| 0541 441 06A | BASIC MATHEMATICS FOR SCIENCE | Apply basic arithmetic operation | 10 |
| Apply algebraic equation and expression | 10 |
| Apply vectors | 10 |
| Apply trigonometry | 50 |
| Apply statistical methods | 40 |
|  |  | **Total** | **120** |
| 1022 541 07A | LABORATORY EQUIPMENT MAINTENANCE | Perform pre-use checks on laboratory equipment | **20** |
| Perform calibration checks on laboratory equipment | **25** |
| Perform equipment cleaning | **25** |
| **Total** | **70** |
| 0533 441 08A | CHEMISTRY TECHNIQUES | Carry out Ph measurement | 60 |
| Analyse chemical sample | 60 |
| Carry out separation technique | 60 |
| **Total** | **180** |
|  |  | **Grand Total** | **340** |

## DIGITAL LITERACY

**UNIT CODE: 0611 451 05A**

**Relationship to Occupational Standards**

This unit addresses the Unit of Competency: Apply Digital Literacy

**Duration of Unit:** 40 Hours

**Unit Description**

This unit covers the competencies required to demonstrate digital literacy. It involves operating computer devices, solving tasks using the Office suite, accessing online/offline data and information, performing online communication and collaboration, applying cybersecurity skills and performing jobs online. It also involves applying job entry techniques.

**Summary of Learning Outcomes**

By the end of this unit, the learner should be able to:

|  |  |  |
| --- | --- | --- |
| **S/No** | **Learning Outcomes** | **Duration (Hours)** |
| 1. | Operate computer devices | **6** |
| 2. | Solve tasks using office suite | **14** |
| 3. | Manage data and information | **6** |
| 4 | Perform online communication and collaboration | 4 |
| 5 | Apply cybersecurity skills | 4 |
| 6 | Perform online jobs | 4 |
| 7 | Apply job entry techniques | 2 |
|  | Total | 40 |

**Learning Outcomes, Content, and Suggested Assessment Methods**

| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| --- | --- | --- |
| 1. Operate computer devices | * 1. Meaning and importance of digital literacy   2. Functions and Uses of Computers   3. Classification of computers   4. Components of a computer system   5. Computer Hardware      1. The System Unit E.g. Motherboard, CPU, casing      2. Input Devices e.g. Pointing, keying, scanning, voice/speech recognition, direct data capture devices.      3. Output Devices e.g. hardcopy output and softcopy output      4. Storage Devices e.g. main memory e.g. RAM, secondary storage (Solid state devices, Hard Drives, CDs & DVDs, Memory cards, Flash drives      5. Computer Ports e.g. HDMI, DVI, VGA, USB type C etc.   6. Classification of computer software   7. Operating system functions   8. Procedure for turning/off a computer   9. Mouse use techniques   10. Keyboard Parts and Use Techniques   11. Desktop Customization   12. File and Files Management using an operating system   13. Computer Internet Connection Options       1. Mobile Networks/Data Plans       2. Wireless Hotspots       3. Cabled (Ethernet/Fiber)       4. Dial-Up   1.14 Satellite  1.15 Computer external devices management   1. Device connections 2. Device controls (volume controls and display properties) | * Observation * Portfolio of Evidence * Project * Written assessment * Practical assessment * Oral assessment |
| 1. Solve tasks using office suite | 1. Meaning and Importance of Word Processing 2. Examples of Word Processors 3. Working with word documents 4. Open and close word processor 5. Create a new document 6. Save a document 7. Switch between open documents 8. Enhancing productivity 9. Set basic options/preferences 10. Help resources 11. Use magnification/zoom tools 12. Display, hide built-in tool bar 13. Using navigation tools 14. Typing Text 15. Document editing (copy, cut, paste commands, spelling and Grammar check) 16. Document formatting 17. Formatting text 18. Formatting paragraph 19. Formatting styles 20. Alignment 21. Creating tables 22. Formatting tables 23. Graphical objects 24. Insert object (picture, drawn object) 25. Select an object 26. Edit an object 27. Format an object 28. Document Print setup   2.9.1 Page layout,  2.9.2 Margins set up  2.9.3 Orientation.   1. Word Document Printing 2. Meaning & Importance of electronic spreadsheets 3. Components of Spreadsheets 4. Application areas of spreadsheets 5. Using spreadsheet application 6. Parts of Excel screen: ribbon, formula bar, active cell, name box, column letter, row number, Quick Access Toolbar. 7. Cell Data Types 8. Block operations 9. Arithmetic operators (formula bar (-, +, 10. Cell Referencing 11. Data Manipulation 12. Using Functions (Sum, Average, SumIF, Count, Max, Max, IF, Rank, Product, mode etc) 13. Using Formulae 14. Sorting data 15. Filtering data 16. Visual representation using charts 17. Worksheet printing     1. Electronic Presentations     2. Meaning and Importance of electronic presentations     3. Examples of Presentation Software     4. Using the electronic presentation application 18. Parts of the PowerPoint screen (slide navigation pane, slide pane, notes, the ribbon, quick access toolbar, and scroll bars). 19. Open and close presentations 20. Creating Slides (Insert new slides, duplicate, or reuse slides.) 21. Text Management (insert, delete, copy, cut and paste, drag and drop, format, and use spell check). 22. Use magnification/zoom tools 23. Apply or change a theme. 24. Save a presentations 25. Switch between open presentations     1. Developing a presentation 26. Presentation views 27. Slides 28. Master slide     1. Text 29. Editing text 30. Formatting 31. Tables     1. Charts 32. Using charts 33. Organization charts     1. Graphical objects 34. Insert, manipulate 35. Drawings     1. Prepare outputs 36. Applying slide effects and transitions     1. Check and deliver 37. Spell check a presentation 38. Slide orientation 39. Slide shows, navigation   2.26 Print presentations (slides and handouts) | * Observation * Portfolio of Evidence * Project * Written assessment * Practical assessment * Oral assessment |
| 1. Manage data and information | 1. Meaning of Data and information 2. Importance and Uses of data and information 3. Types of internet services    1. Communication Services    2. Information Retrieval Services    3. File Transfer    4. World Wide Web Services    5. Web Services    6. Automatic Network Address Configuration    7. News Group    8. Ecommerce    9. Types of Internet Access Applications    10. Web browsing concepts    11. Key concepts    12. Security and safety    13. Web browsing    14. Using the web browser    15. Tools and settings    16. Clearing Cache and cookies    17. URIs    18. Bookmarks    19. Web outputs    20. Web based information    21. Search    22. Critical evaluation of information    23. Copyright, data protection    24. Downloads Management    25. Performing Digital Data Backup (Online and Offline)    26. Emerging issues in internet | * Observation * Portfolio of Evidence * Project * Written assessment * Practical assessment * Oral assessment |
| 1. Perform online communication and collaboration | 1. Netiquette principles 2. Communication concepts    1. Online communities    2. Communication tools    3. Email concepts 3. Using email    1. Sending email    2. Receiving email    3. Tools and settings    4. Organizing email 4. Digital content copyright and licenses 5. Online collaboration tools    1. Online Storage (Google Drive)    2. Online productivity applications (Google Docs & Forms)    3. Online meetings (Google Meet/Zoom)    4. Online learning environments    5. Online calendars (Google Calendars)    6. Social networks (Facebook/Twitter - Settings & Privacy) 6. Preparation for online collaboration    1. Common setup features    2. Setup 7. Mobile collaboration    1. Key concepts    2. Using mobile devices    3. Applications    4. Synchronization | * Observation * Portfolio of Evidence * Project * Written assessment * Practical assessment * Oral assessment |
| 1. Apply cybersecurity skills | 1. Data protection and privacy    1. Confidentiality of data/information    2. Integrity of data/information    3. Availability of data/information    4. Internet security threats    5. Malware attacks    6. Social engineering attacks    7. Distributed denial of service (DDoS)    8. Man-in-the-middle attack (MitM)    9. Password attacks    10. IoT Attacks    11. [Phishing Attacks](https://onlinedegrees.sandiego.edu/top-cyber-security-threats/#phishing-attacks)    12. [Ransomware](https://onlinedegrees.sandiego.edu/top-cyber-security-threats/#ransomware)    13. Computer threats and crimes    14. Cybersecurity control measures 2. Physical Controls 3. Technical/Logical Controls (Passwords, PINs, Biometrics) 4. Operational Controls    1. Laws governing protection of ICT in Kenya 5. The Computer Misuse and Cybercrimes Act No. 5 of 2018 6. The Data Protection Act No. 24 Of 2019 | * Observation * Portfolio of Evidence * Project * Written assessment * Practical assessment * Oral assessment |
| 1. Perform online jobs | 1. Introduction to online working 2. Types of online Jobs 3. Online job platforms    1. Remotask    2. Data annotation tech    3. Cloud worker    4. Upwork    5. Oneforma    6. Appen 4. Online account and profile management 5. Identifying online jobs/job bidding 6. Online digital identity 7. Executing online tasks 8. Management of online payment accounts. | * + Observation   + Oral assessment   + Portfolio of evidence   + Third party report   + Written assessment |
| 1. Apply job entry techniques | 1. Types of job opportunities 2. Self-employment 3. Service provision 4. product development 5. salaried employment 6. Sources of job opportunities 7. Resume/ curriculum vitae 8. What is a CV 9. How long should a CV be 10. What to include in a AC 11. Format of CV 12. How to write a good CV 13. Don’ts of writing a CV     1. Job application letter 14. What to include 15. Addressing a cover letter 16. Signing off a cover letter     1. Portfolio of Evidence 17. Academic credentials 18. Letters of commendations 19. Certification of participations 20. Awards and decorations     1. Interview skills 21. Listening skills 22. Grooming 23. Language command 24. Articulation of issues 25. Body language 26. Time management 27. Honesty     1. Generally knowledgeable in current affairs and technical area | * + Observation   + Oral assessment   + Portfolio of evidence   + Written assessment |

**Suggested Methods Instruction**

* + Practical
  + Projects
  + Demonstrations
  + Group discussions
  + Direct instruction

**Recommended Resources for 25 Trainees**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S/No.** | **Category/Item** | **Description/ Specifications** | **Quantity** | **Recommended Ratio**  (Item: Trainee) |
| **A** | **Learning Materials** | | | |
|  | Power point presentations | For trainer’s use | 1 | 1:25 |
|  | Sample CVs | For trainee’s use | 5 | 1:5 |
|  | * Sample job applications | For trainee’s use | 5 | 1:5 |
| **B** | **Learning Facilities & infrastructure** | | | |
|  | Lecture/theory room |  | 1 | 1:25 |
|  | Computers with OS (Windows/Linux/Mac), Microsoft Office, Google Workspace, Antivirus | For trainee’s use | 25 | 1:1 |
|  | Internet connection | For trainees and trainer’s use | 1 connection | 1:25 |
|  | Whiteboard | For trainer’s use | 1 | 1:25 |
|  | Smartboard/Smart TV (Where applicable) | For trainer’s use | 1 | 1:25 |
| **C** | **Consumable materials** | | | |
|  | Printing papers | For trainer and trainee use | Varies | Varies |
|  | Assorted whiteboard markers | For trainer’s use | Varies | Varies |
| **D** | **Tools and Equipment** | | | |
|  | Printers | For trainer’s use | 2 | 1:12 |
|  | External storage media | For trainer and trainee use | Varies | 1:1 or 1:5 depending on need |
|  | Projector | For trainer’s use | 1 | 1:25 |

## BASIC MATHEMATICS FOR SCIENCE

**UNIT CODE: 0541 441 06A**

**UNIT DURATION:**  120 Hours

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Apply Basic Mathematics for science.

**Duration of Unit**: 120 hours

**Unit Description**

This unit specifies the competencies required to apply fundamental mathematical techniques. It involves applying basic arithmetic operations, solving algebraic equations and expressions, performing vector operations, using trigonometric principles, and applying statistical methods.

**Summary of Learning Outcomes**

By the end of this unit, the learner should be able to:

|  |  |  |
| --- | --- | --- |
| **S/No** | **Learning Outcomes** | **Duration (Hours)** |
| 1. | Apply basic arithmetic operation | 10 |
| 2. | Apply algebraic equation and expression | 10 |
| 3. | Apply vectors | 10 |
| 4 | Apply trigonometry | 50 |
| 5 | Apply statistical methods | 40 |
|  | Total | 120 |

**Learning Outcomes, Content and Suggested Assessment Methods**

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Apply basic arithmetic operation | 1. Addition and subtraction on;    * 1. Natural numbers      2. Integers      3. Fractions      4. Decimals 2. Multiplication and division on;    * 1. Natural numbers      2. Integers      3. Fractions      4. Decimals 3. Ratios, proportions and percentages    * 1. Direct proportion      2. Inverse proportion 4. Indices    * 1. Bases      2. Laws of indices      3. Indicial equations | * Practical * Project * Third party report * Portfolio of evidence * Written test * Oral test |
| 1. Apply algebraic equation and expression | * 1. Solution of linear equations   2. Solution of simultaneous      1. Elimination method      2. Substitution method      3. Graphical method   3. Linear graphs      1. Co-ordinates      2. Plotting of points      3. Graphs of straight lines   4. Solution of quadratic equations      1. Factorization      2. Completing square method      3. Quadratic formula | * Practical * Project * Third party report * Portfolio of evidence * Written test * Oral test |
| 1. Apply vectors | 1. Introduction to vectors 2. Definition of vectors 3. Vector quantities 4. Scalar quantity 5. Vectors addition 6. Vectors subtraction 7. Vectors multiplication 8. Position of vectors 9. Modulus of a vector | * Practical * Project * Third party report * Portfolio of evidence * Written test * Oral test |
| 1. Apply trigonometry | 1. Pythagoras theorem 2. Trigonometric ratios    * 1. Sine      2. Cosine      3. tangent 3. Trigonometric operations    * 1. Trigonometric identities      2. Trigonometric equations      3. Sine rule      4. cosine rule      5. Tangent rule 4. Angles of elevation and depression | * Practical * Project * Third party report * Portfolio of evidence * Written test * Oral test |
| 1. Apply statistical methods | * 1. Collection of raw data  1. Ungrouped data 2. Grouped data    1. Data presentation 3. Pictograms 4. Histograms 5. Pie charts 6. Bar charts 7. Frequency polygon    1. Processing of raw data    2. Measures of central tendency       * 1. Mean         2. Mode         3. Median | * Practical * Project * Third party report * Portfolio of evidence * Written test * Oral test |

**Suggested Delivery Methods**

* Practical
* projects
* Group discussions
* Demonstration
* Direct instruction

**Recommended Resources for 25 trainees**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S/No.** | **Category/Item** | **Description/ Specifications** | **Quantity** | **Recommended Ratio**  (Item: Trainee) |
| **A** | **Learning Materials** | | | |
|  | Power point presentations | For trainer’s use | 1 | 1:25 |
|  |  |  |  |  |
| **B** | **Learning Facilities & infrastructure** | | | |
|  | Lecture room | For training | 1 | 1:25 |
|  |  |  |  |  |
| **C** | **Tools and Equipment** | | | |
|  | Computer | For trainer’s use | 1 | 1:25 |
|  | Scientific calculator | For trainee’s use | 25 | 1:1 |
|  | Projector | For trainer’s use | 1 | 1:25 |
|  | Graph book | For trainee’s use | 25 | 1:1 |
|  | SMP Mathematical table | For trainee’s use | 25 | 1:1 |
|  | White board ruler | For trainer’s use | 1 | 1:25 |
|  | White board compass | For trainer’s use | 1 | 1:25 |
|  | White board protractor | For trainer’s use | 1 | 1:25 |
|  | Geometrical set | For trainee’s use | 25 | 1:1 |

## LABORATORY EQUIPMENT MAINTENANCE

**UNIT CODE: 1022 541 07A**

**Duration of Unit:** 80 Hours

**Relationship to Occupational Standards**

This unit addresses the unit of competency: Maintain laboratory equipment.

**Unit Description**

This unit of competency covers the ability of a laboratory technologist to perform pre-use checks on laboratory equipment, perform calibration checks on laboratory equipment and perform equipment cleaning.

**Summary of Learning Outcomes**

By the end of this unit, the learner should be able to:

|  |  |  |
| --- | --- | --- |
| **S/No** | **Learning Outcomes** | **Duration (Hours)** |
|  | Perform pre-use checks on laboratory equipment | **20** |
|  | Perform calibration checks on laboratory equipment | **25** |
|  | Perform equipment cleaning | **25** |
|  | **Total** | **70** |

**Learning Outcomes, Content and Suggested Assessment Methods**

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Perform pre-use checks on laboratory equipment. | 1. Parts of laboratory equipment 2. Functions of laboratory equipment | * Practical Assessment * Project-Based Assessment * Portfolio of Evidence * Written Assessment |
| 1. Perform calibration checks on laboratory equipment. | 1. Calibration of laboratory equipment 2. Operation procedures of laboratory equipment | * Practical Assessment * Project-Based Assessment * Portfolio of Evidence * Written Assessment |
| 1. Perform equipment cleaning. | 1. Maintenance of laboratory equipment 2. Dusting and cleaning 3. Lubrication 4. Overhaul maintenance 5. Calibration | * Practical Assessment * Project-Based Assessment * Portfolio of Evidence * Written Assessment |

**Suggested Delivery Methods**

* + Practical
  + Projects
  + Demonstrations
  + Group discussions
  + Direct instruction

**Recommended Resources for 25 Trainees**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S/No.** | **Category/Item** | **Description/ Specifications** | **Quantity** | **Recommended Ratio**  **(Item: Trainee)** |
| **A** | **Learning Materials** | | | |
|  | Power point presentations | For trainer’s use | 1 | 1:25 |
|  | Computer | For trainer’s use | 1 | 1:25 |
|  | Projector |  | 1 | 1:25 |
|  | Standard manuals/SOPs | For trainer’s use | **1** | 1:25 |
|  | Flip charts | For trainer’s use | **1** | 1:25 |
|  | Stationeries | For trainee use | **25** | 1:1 |
| **B** | **Learning Facilities & infrastructure** | | | |
|  | **Lecture/theory room** |  |  |  |
|  | Fully equipped science laboratory | For trainee use | **1** | 1:25 |
|  | Lecture room | For trainee use | **1** | 1:25 |
| **C** | **Consumable materials** | | | |
| **1.** | Disinfectant | For trainee use | **25** | 1:1 |
|  | Gloves | For trainee use | **25** | 1:1 |
|  | Laboratory coats | For trainee use | **25** | 1:1 |
|  | Face Masks | For trainee use | **25** | 1:1 |
| **D** | **Tools and Equipment** | | | |
|  | Projector |  | 1 | 1:25 |
|  | First aid kit | For trainee use | **1** | 1:25 |
|  | Goggles | For trainee use | **25** | **1:1** |
|  | Safety boots | For trainee use | **25** | **1:1** |

## CHEMISTRY TECHNIQUES

**UNIT CODE: 0531 441 08A**

**UNIT DURATION**: 180 Hours

**Relationship to Occupational Standards**

This unit addresses the Unit of Competency: **Perform Chemistry Techniques**

**Unit Description**

This unit specifies the competencies required to perform chemistry techniques. It involves carrying out pH measurements, analyzing chemical samples and carrying out separation techniques.

**Summary of Learning Outcomes**

By the end of this unit, the learner should be able to:

|  |  |  |
| --- | --- | --- |
| **S/No** | **Learning Outcomes** | **Duration (Hours)** |
| 1. | Carry out Ph measurement | 60 |
| 2. | Analyse chemical sample | 60 |
| 3. | Carry out separation technique | 60 |
|  | **Total** | 180 |

**Learning Outcomes, Content and Suggested Assessment Methods**

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Carry out pH measurement | * 1. Assemble pH apparatus and equipment  1. Indicator papers 2. Glassware 3. Glassware 4. Hot plates 5. Burettes 6. Pipettes 7. Magnetic stirrer plates 8. Bunsen burners 9. Spatulas 10. Crucibles 11. Tripod stand 12. Clamp and stand 13. Test tube racks 14. Tongs     1. Measurement Sample pH 15. Distilled water 16. pH indicator solutions 17. Organic solvents 18. Inorganic solvents 19. Reported sample pH result | * Practical * Projects * Demonstrations * Group discussion * Direct Instructions * Written tests |
| 1. Analyse chemical sample | * 1. Assemble chemical analysis apparatus and equipment      1. Glassware  1. Hot plates 2. Burettes 3. Pipettes 4. Magnetic stirrer plates 5. Bunsen burners 6. Spatulas 7. Crucibles 8. Tripod stand 9. Clamp and stand 10. Test tube racks 11. Tongs 12. Analytical balances 13. Ovens 14. Karl Fischer titrators     1. Prepare chemical samples and reagents 15. Alcoholic beverages 16. Food substances 17. Petroleum products 18. Soil 19. Gases 20. Metal ores 21. Mineral salts 22. Organic acids 23. Inorganic acids 24. Organic bases 25. Inorganic bases 26. Polar solvents 27. Non-polar solvents     1. Perform chemical analysis 28. Volumetric 29. Gravimetric 30. Flame photometry 31. Colorimetry     1. Reported chemical analysis results | * Practical * Projects * Demonstrations * Group discussion * Direct Instructions * Written tests |
| 1. Carry out separation technique | * 1. Assemble Separation technique apparatus and equipment  1. Glassware 2. Pestle and mortar 3. Water bath 4. Separating funnel 5. Hot plates 6. Magnetic stirrer plates 7. Bunsen burners 8. Spatula 9. Crucibles 10. Tripod stand 11. Filter paper 12. Clamp and stand 13. Chromatography paper 14. Thin layer chromatography development chamber 15. Tongs 16. Distillation apparatus 17. Soxhlet apparatus 18. Analytical balance 19. Oven 20. Furnace 21. Fridge     1. Prepare chemical sample and separation reagent        1. Organic solvents        2. Distilled water        3. Inorganic solvents     2. Perform sample separation        1. Distillation        2. Evaporation        3. Paper chromatography        4. Decantation        5. Extraction        6. Filtration        7. Crystallization     3. Report separation result | * Practical * Projects * Demonstrations * Group discussion * Direct Instructions * Written tests |

**Suggested Methods of Instruction**

* Practical
* Projects
* Demonstrations
* Group discussion
* Direct Instructions

**Recommended Resources for 25 Trainees**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S/No.** | **Category/Item** | **Description/ Specifications** | **Quantity** | **Recommended Ratio**  **(Item: Trainee)** |
| **A** | **Learning Materials** | | | |
|  | Desktop computer/laptop | For trainer’s use | 2 | 1:12 |
|  | Projector | For trainer’s use | 1 | 1:25 |
|  | Standard laboratory manuals | For trainer’s use | 1 | 1:25 |
|  | Flip charts | For trainer’s use | 1 | 1:25 |
|  | Whiteboard | For trainer’s use | 1 | 1:25 |
|  | Assorted reference materials | For trainer’s and trainee use | 5 | 5:25 |
|  | Separation technique apparatus | For trainee use | 5 | 1:5 |
|  | Assorted chemical samples | For trainee use | 5 | 1:5 |
| **B** | **Learning Facilities & infrastructure** | | | |
| 1. | Lecture/theory room | For trainer’s and trainee use | 1 | 1:25 |
| 2. | Standard Science laboratory | For trainee use | 1 | 1:25 |
| 3. | Internet connection | For trainee use | Enough |  |
| 4. | Assorted analytical instruments | For trainer’s and trainee use | 1 | 1:25 |
| **C** | **Consumable materials** | | | |
| 1. **1** | Stationeries | For trainee use | 25 | 1:1 |
| 1. **2** | Gloves | For trainee use | 25 | 1:1 |
|  | Masks | For trainee use | 25 | 1:1 |
|  | Assorted Glassware | For trainee use | enough | 1:1 |
|  | Assorted equipment | For trainee use | enough | 1:5 |
|  | Pestle and mortars | For trainee use | 12 | 1:2 |
|  | Desiccators | For trainee use | 4 | 1:8 |
| 1. **10** | Droppers/teat pipettes | For trainee use | 25 | 1:1 |
| 1. **11** | Assorted chemicals [acids, bases, solvents, salts] | For trainee use | enough | 1:1 |
|  | Calibration standards | For trainer and trainee use | enough | 1:1 |
| **D** | **Tools and Equipment** | | | |
| **1.** | Analytical balances | For trainee use | 5 | 1:5 |
| **2.** | First aid kit | For trainee use | 5 | 1:25 |
| **3.** | Muffle Furnace | For trainee use | 1 | 1:25 |
| **4** | oven | For trainee use | 2 | 1:12 |
| **5** | centrifuges | For trainee use | 4 | 1:6 |
| **6** | refrigerator/freezer | For trainee use | 1 | 1:25 |
| **7** | Desiccators | For trainee use | 4 | 1:8 |
| **8** | Water bath | For trainee use | 3 | 1:8 |
| **9** | hot plate | For trainee use | 6 | 1:4 |
| **10** | Magnetic stirrer | For trainee use | 4 | 1:6 |
| **11** | colorimetric | For trainer and trainee use | 1 | 1:25 |
| **12** | Atomic Emission spectrophotometer | For trainer and trainee use | 1 | 1:25 |
| **13** | Soxhlet extractor | For trainee use | 5 | 1:5 |
| **12** | pH meter | For trainee use | 5 | 1:5 |
| **13** | pH testing pens | For trainee use | 5 | 1:5 |
| **14** | Buffer solutions | For trainee use | 5 | 1:5 |
| **15** | Sample storage apparatus | For trainee use | 25 | 1:1 |
| **16** | Magnetic stirrers | For trainee use | 5 | 1:5 |
| **19** | Titration apparatus | For trainee use | 25 | 1:1 |
| **17** | Separation technique apparatus | For trainee use | 5 | 1:5 |

# MODULE III UNITS OF LEARNING

# MODULE SUMMARY

The table presented below outlines the units and credit factors included in this module.

|  |  |  |  |
| --- | --- | --- | --- |
| **UNIT CODE** | **UNIT NAME** | **ELEMENTS** | **DURATION (HOURS)** |
| 0417 441 09A | WORK ETHICS AND PRACTICES | Apply self-management skills | **10** |
| Promote ethical work practices and values | **4** |
| Promote team work | **10** |
| Maintain professional and personal development | **10** |
| Apply problem solving skills | **4** |
| Promote customer care | **2** |
| **Total** | **40** |
| 0413 441 10A | ENTREPRENEURIAL SKILLS | Apply financial literacy skills | **6** |
| Apply the entrepreneurial concept | **4** |
| Identify entrepreneurship opportunities | **10** |
| Apply business legal aspects | **6** |
| Innovate business strategies | **6** |
| Develop a business plan | **12** |
|  |  | **Total** | **40** |
| 0588 441 11A | SCIENCE LABORATORY RESEARCH | Prepare science laboratory research data collection tools | **30** |
| Carry out science laboratory research data collection | **40** |
| Carry out science laboratory research data analysis | **30** |
| Total | **100** |
| 0533 441 12A | PHYSICS TECHNIQUES | Measure physical quantities | **20** |
| Perform pressure experiment | **20** |
| Measure heat capacity | **30** |
| Conduct wave experiment | **20** |
| Perform optical experiment | **20** |
| Conduct electrical experiment. | **20** |
| Carry out electromagnetism experiment | **30** |
| Perform particulate nature of matter experiment | **20** |
| **Total** | **180** |
| **GRAND TOTAL** | **360** |

## WORK ETHICS AND PRACTICES

**UNIT CODE:** 0417 441 09A

**Relationship to Occupational Standards**

This unit addresses the Unit of Competency: Apply work ethics and practices.

**Duration of Unit:** 40 hours

**Unit Description**

This unit covers competencies required to demonstrate employability skills. It involves the ability to: conduct self-management, promote ethical work practices and values, promote teamwork, manage workplace conflicts, maintain professional and personal development, apply problem-solving, and promote customer care.

**Summary of Learning Outcomes**

By the end of this unit, the learner should be able to:

|  |  |  |
| --- | --- | --- |
| **S/No** | **Learning Outcomes** | **Duration (Hours)** |
| 1. | Apply self-management skills | **10** |
| 2. | Promote ethical work practices and values | **4** |
| 3. | Promote team work | **10** |
| 4 | Maintain professional and personal development | **10** |
| 5 | Apply problem solving skills | **4** |
| 6 | Promote customer care | **2** |
|  | **Total** | **40** |

**Learning Outcomes, Content, and Suggested Assessment Methods**

| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| --- | --- | --- |
| 1. Apply self-management skills | 1. Self-awareness 2. Formulating personal vision, mission, and goals 3. Healthy lifestyle practices 4. Strategies for overcoming work challenges 5. Emotional intelligence 6. Coping with Work Stress. 7. Assertiveness versus aggressiveness and passiveness 8. Developing and maintaining high self-esteem 9. Developing and maintaining positive self-image 10. Time management 11. Setting performance targets 12. Monitoring and evaluating performance targets | * Observation * Portfolio of evidence * Project * Practical * Written assessment * Oral assessment |
| 1. Promote ethical work practices and values | * 1. Integrity   2. Core Values, ethics and beliefs   3. Patriotism   4. Professionalism   5. Organizational codes of conduct   6. Industry policies and procedures | * Portfolio of evidence * Project * Practical * Observation * Written assessment * Oral assessment |
| 1. Promote teamwork | * 1. Types of teams   2. Team building   3. Individual responsibilities in a team   4. Determination of team roles and objectives   5. Team parameters and relationships   6. Benefits of teamwork   7. Qualities of a team player  1. Leading a team 2. Team performance and evaluation 3. Conflicts and conflict resolution 4. Gender and diversity mainstreaming 5. Developing Healthy workplace relationships 6. Adaptability and flexibility 7. Coaching and mentoring skills | * Observation * Written assessment * Oral assessment * Portfolio of evidence * Project * Practical |
| 1. Maintain Professional and Personal Development | 1. Personal vs professional development and growth 2. Avenues for professional growth 3. Recognizing career advancement 4. Training and career opportunities 5. Assessing training needs 6. Mobilizing training resources 7. Licenses and certifications for professional growth and development 8. Pursuing personal and organizational goals 9. Managing work priorities and commitments 10. Dynamism and on-the-job learning | * Project * Practical * Observation * Written assessment * Oral assessment * Portfolio of evidence |
| 1. Apply problem-solving skills | 1. Causes of problems 2. Methods of solving problems 3. Problem-solving process 4. Decision making 5. Creative thinking and critical thinking process in development of innovative and practical solutions | * Observation * Project * Portfolio of evidence * Practical * Written assessment * Oral assessment |
| 1. Promote customer care | 1. Identifying customer needs 2. Qualities of good customer service 3. Customer feedback methods 4. Resolving customer concerns 5. Customer outreach programs 6. Customer retention | * Observation * Project * Practical * Portfolio of evidence * Written assessment * Oral assessment |

**Suggested Methods of Instruction**

* + Practical
  + Projects
  + Demonstrations
  + Group discussions
  + Direct instruction

**Recommended Resources for 25 Trainees**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S/No.** | **Category/Item** | **Description/ Specifications** | **Quantity** | **Recommended Ratio**  (Item: Trainee) |
| **A** | **Learning Materials** | | | |
|  | Power point presentations | For trainer’s use | 1 | 1:25 |
|  | Charts | For trainees and Trainer’s use | 6-10 | 1:5 pr 1:10 |
|  | * Video clips | For trainees and Trainer’s use | Varies | Varies |
|  | Audio tapes | For trainees and Trainer’s use | Varies | Varies |
| **B** | **Learning Facilities & infrastructure** | | | |
|  | Lecture/theory room | For Trainer/trainee’s use | 1 | 1:25 |
|  | Computers | For trainee’s use | 25 | 1:1 |
|  | Radio sets | For trainee’s use | 3-5 | 1:5 or 1:10 |
|  | TV sets | For trainee’s use | 3-5 | 1:5 or 1:10 |
| **C** | **Consumable materials** | | | |
|  | Stationery | For trainees and trainer’s use | Varies | Varies |
| **D** | **Tools and Equipment** | | | |
|  | LCD projectors | For trainer’s use | 1 | 1:25 |

## ENTREPRENEURIAL SKILLS

**UNIT CODE:** 0413 441 10A

**Relationship to occupational standards**

This unit addresses the unit of competency: Apply Entrepreneurial skills.

**Duration of unit:** 40 hours

**Unit Description:**

This unit covers the competencies required to demonstrate an understanding of entrepreneurship. It involves demonstrating an understanding of financial literacy, applying entrepreneurial concepts, identifying entrepreneurship opportunities, applying business legal aspects, and developing business innovative strategies and business plans.

**Summary of Learning Outcomes**

By the end of this unit, the learner should be able to:

|  |  |  |
| --- | --- | --- |
| **S/No** | **Learning Outcomes** | **Duration (Hours)** |
| 1. | Apply financial literacy skills | **6** |
| 2. | Apply the entrepreneurial concept | **4** |
| 3. | Identify entrepreneurship opportunities | **6** |
| 4 | Apply business legal aspects | **6** |
| 5 | Innovate business strategies | **6** |
| 6 | Develop a business plan | **12** |
|  | **Total** | **40** |

**Learning Outcomes, Content and Suggested Assessment Methods**

| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| --- | --- | --- |
| 1. Apply Financial Literacy | 1. Personal finance management 2. Balancing between needs and wants 3. Budget Preparation 4. Saving management 5. Factors to consider when deciding where to save 6. Debt management 7. Factors to consider before taking a loan 8. Investment decisions 9. Types of investments 10. Factors to consider when investing money 11. Insurance services 12. insurance products available in the market 13. Insurable risks | * Practical * Portfolio of evidence * Project * Observation * Written assessment * Oral assessment * Third party reports * Interviews |
| 2.Apply Entrepreneurial Concept | * 1. Difference between Entrepreneurs and Business persons   2. Types of entrepreneurs   3. Ways of becoming an entrepreneur   4. Characteristics of Entrepreneurs   5. salaried employment and self-employment   6. Requirements for entry into self-employment   7. Roles of an Entrepreneur in an enterprise   8. Contributions of Entrepreneurship | * Observation * Project * Written assessment * Oral assessment * Third party report |
| 3.Identify Entrepreneurship Opportunities | * 1. Sources of business ideas   2. Factors to consider when evaluating business opportunity   3. Business life cycle | * Observation * Project * Written assessment * Oral assessment * Third party report |
| 4.Apply Business Legal Aspects | * 1. Forms of business ownership   2. Business registration and licensing processing   3. Types of contracts and agreements   4. Employment laws   5. Taxation laws | * Observation * Project * Written assessment * Oral assessment * Third party report |
| 5.Innovate Business Strategies | * 1. Creativity in business   2. Innovative business strategies   3. Entrepreneurial Linkages   4. ICT in business growth and development | * Observation * Project * Written assessment * Oral assessment * Third party report |
| 6.Develop Business Plan | * 1. Business description   2. Marketing plan   3. Organizational/Management   4. plan   5. Production/operation plan   6. Financial plan   7. Executive summary   8. Business plan presentation   9. Business idea incubation | * Observation * Written assessment * Project * Oral assessment * Third party report |

**Suggested Methods of Instruction**

* Direct instruction with active learning strategies
* Project (Business plan)
* Case studies
* Field trips
* Group Discussions
* Demonstration
* Question and answer
* Problem solving
* Experiential
* Team training
* Guest speakers

**Recommended Resources for 25 trainees**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S/no.** | **Category/item** | **Description/specification** | **Quantity** | **Recommended ratio(item: trainee)** |
| 1. **Learning materials** | | | | |
|  | Report writing templates | Digital report template | 5 | 1:5 |
|  | Flashcards | Educational flash cards | 5 | 1:5 |
|  | Flip charts | Educational flip charts | 5 | 1:5 |
| 1. **Learning facilities and infrastructure** | | | | |
|  | Lecture/theory room | 72m2 | 1 | 1:25 |
|  | Whiteboard | 4 feet by 8 feet | 1 | 1:25 |
|  | Projector | LCD High resolution | 1 | 1:25 |
|  | Computers | RAM: 8GB | 25 | 1:25 |
|  | Printers | Ink Jet | 2 | 1:13 |
| 1. **Consumable materials** | | | | |
|  | Printing Papers | A4 | Enough for 25 | 1:25 |
|  | Assorted whiteboard markers | Non-permanent | Enough for 25 | 1:25 |
| 1. **Tools and equipment** | | | | |
|  | Mobile phones | Functioning smart phone | Enough for 25 | 1:25 |

## SCIENCE LABORATORY RESEARCH

**UNIT CODE:** 0588 441 11A

**UNIT DURATION:**  100 Hours

**Relationship to Occupational Standards**

This unit addresses the Unit of Competency: Conduct Science Laboratory research.

**Unit Description**

This unit outlines the necessary competencies for performing research in a science laboratory. It includes the preparation of tools for data collection, the execution of data collection in the laboratory, and the analysis of the collected research data.

**Summary of Learning Outcomes**

By the end of this unit, the learner should be able to:

|  |  |  |
| --- | --- | --- |
| **S/No** | **Learning Outcomes** | **Duration (Hours)** |
| 1. | Prepare science laboratory research data collection tools | **30** |
| 2. | Carry out science laboratory research data collection | **40** |
| 3. | Carry out science laboratory research data analysis | **30** |
|  | Total | **100** |

**Learning Outcomes, Content and Suggested Assessment Methods**

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Prepare science laboratory research data collection tools. | 1. Project topics 2. Literature review 3. Study site 4. Sample size determination 5. Materials and methods 6. Ethical considerations 7. Data collection tools:    * 1. Questionnaires      2. Photography      3. Videos tapes      4. Google forms | * Practical * Project * Third party report * Portfolio of evidence * Written test * Oral test |
| 1. Carry out science laboratory research data collection. | * 1. Data collection methods      1. Interviews      2. Surveys      3. Observations   2. Experiments   3. Secondary data sources   4. Direct measurements | * Practical * Project * Third party report * Portfolio of evidence * Written test * Oral test |
| 1. Carry out science laboratory research data analysis | 1. Data organization    * 1. Data formatting      2. Data cleaning      3. Data coding    1. Data analysis methods    2. Compiling of research report.       1. Results       2. Discussion       3. Conclusion       4. Recommendations       5. References\       6. Appendices    3. Submission of the research report | * Practical * Project * Third party report * Portfolio of evidence * Written test * Oral test |

**Suggested Methods of Instruction**

* Demonstration
* Viewing of related videos
* Discussion
* Direct Instruction

**Recommended Resources for 25 Trainees**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S/No.** | **Category/Item** | **Description/ Specifications** | **Quantity** | **Recommended Ratio**  **(Item: Trainee)** |
| **A** | **Learning Materials** | | | |
|  | Power point presentations | For trainer’s use | 1 | 1:25 |
|  | Computer | For trainer’s use | 1 | 1:25 |
|  | Projector | For trainer’s use | 1 | 1:25 |
|  | Standard manuals/SOPs | For trainer’s use | **1** | 1:25 |
|  | Flip charts | For trainer’s use | **1** | 1:25 |
|  | Stationeries | For trainee use | **25** | 1:1 |
| **B** | **Learning Facilities & infrastructure** | | | |
|  | **Lecture/theory room** |  |  |  |
|  | Standard science laboratory | For trainee use | **1** | 1:25 |
|  | Lecture room | For trainee use | **1** | 1:25 |
| **C** | **Consumable materials** | | | |
| **1.** | Disinfectant | For trainee use | **25** | 1:1 |
|  | Gloves | For trainee use | **25** | 1:1 |
|  | Laboratory coats | For trainee use | **25** | 1:1 |
|  | Face Masks | For trainee use | **25** | 1:1 |
| **D** | **Tools and Equipment** | | | |
|  | First aid kit | For trainee use | **1** | 1:25 |
|  | Goggles | For trainee use | **25** | **1:1** |
|  | Safety boots | For trainee use | **25** | **1:1** |

## PHYSICS TECHNIQUES

**UNIT CODE: 0533 441 12A**

**UNIT DURATION:**  180 Hours

**Relationship to Occupational Standards**

This unit addresses the Unit of Competency: Perform Physics Techniques

**Unit Description**

This unit specifies the competencies required to perform physics techniques. It involves measuring physical quantities, performing pressure experiment, measuring heat capacity, conducting wave experiment, performing optical experiment, conducting electrical experiment, carrying out electromagnetism experiment and performing particulate nature of matter experiment.

**Summary of Learning Outcomes**

By the end of this unit, the learner should be able to:

|  |  |  |
| --- | --- | --- |
| **S/No** | **Learning Outcomes** | **Duration (Hours)** |
| 1. | Measure physical quantities | **20** |
| 2. | Perform pressure experiment | **20** |
| 3. | Measure heat capacity | **30** |
| 4 | Conduct wave experiment | **20** |
| 5 | Perform optical experiment | **20** |
| 6 | Conduct electrical experiment. | **20** |
| 7 | Carry out electromagnetism experiment | **30** |
| 8 | Perform particulate nature of matter experiment | **20** |
|  | **Total** | **180** |

**Learning Outcomes, Content and Suggested Assessment Methods**

|  |  |  |
| --- | --- | --- |
| **Learning Outcome** | **Content** | **Suggested Assessment Methods** |
| 1. Measure physical quantities | 1. Basic and derived physical quantities 2. SI units 3. Conversion of units 4. Measuring instruments 5. Measuring physical quantities 6. Archimedes principle 7. Upthrust 8. Law of floatation 9. Density and Relative density | * Practical Assessment * Written * Oral * Observation * Third party |
| 1. Perform pressure experiment | * 1. Definition of pressure   2. Pressure in solids, liquids and gases   3. Transmission of pressure in liquids      1. Hydraulics   4. Measurements of pressure   5. Atmospheric pressure   6. Applications of pressure | * Practical Assessment * Written * Oral * Observation * Third party |
| 1. Measure heat capacity | 1. Definition of heat, heat transfer and thermal equilibrium 2. Temperature scales 3. Modes of heat transfer 4. Change of states 5. Application of heat on matter 6. Thermal expansivity 7. Heat capacities 8. Latent heat | * Practical Assessment * Written * Oral * Observation * Third party |
| 1. Conduct wave experiment | * 1. Types of waves      1. characteristics of wave motion      2. wavelength      3. frequency      4. period      5. speed      6. amplitude   2. Properties of waves   3. Reflection   4. Refraction   5. Diffraction   6. Interference | 1. Practical Assessment 2. Written 3. Oral 4. Observation 5. Third party |
| 1. Perform optical experiment | * 1. Nature of light   2. Propagation of light   3. Laws of reflection   4. Polarisation   5. Image formation by plain & curved mirrors   6. Laws of refraction.   7. Distances, sizes of object/images, magnification and focal lengths are determined as per the mirror and lens formula   Refractive index, critical angle and total internal reflection.   * 1. Image formation by lenses   2. Optical instruments | * Practical Assessment * Written * Oral * Observation * Third party |
| 1. Conduct electrical experiment | * 1. Electrical quantities  1. Current 2. Resistance 3. Voltage 4. Electromotive force (emf) 5. Potential Difference (pd)    1. Electrical Circuits 6. Series 7. parallel    1. Electrical measuring instruments    2. Ohm’s law    3. Factors affecting resistance       1. Length       2. Cross section area       3. Temperature       4. Nature of the material/resistivity    4. Resistor networks       1. Parallel       2. series | * Practical Assessment * Written * Oral * Observation * Third party |
| 1. Carry out electromagnetism experiment | * 1. Types of magnets   2. Properties of Magnetism   3. Magnetization and de-magnetization methods   4. Uses of magnets   5. Laws of electromagnetism   6. Applications of electromagnetism | * Practical Assessment * Written * Oral * Observation * Third party |
| 1. Perform particulate nature of matter experiment | * 1. States of matter   2. Properties of matter.   3. Brownian motion | * Practical Assessment * Written * Oral * Observation * Third party |

**Suggested Methods of Instruction**

* Demonstration
* Viewing of related videos
* Discussion
* Direct Instruction
* Field study

**Recommended Resources for 25 Trainees**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **S/No.** | **Category/Item** | **Description/ Specifications** | **Quantity** | **Recommended Ratio**  (Item: Trainee) |
| **A** | **Learning Materials** | | | |
|  | Desktop computer/laptop | For trainer’s use | 1 | 1:25 |
|  | Internet connection | wifi |  | 1:25 |
|  | Projector |  | 1 | 1:25 |
|  | Whiteboard | 4 x 8 ft | 1 | 1:25 |
|  | Assorted colour of whiteboard markers | Red, blue and black | 3 | 1:25 |
| **B** | **Learning Facilities & infrastructure** | | | |
|  | standard Science laboratory |  | 1 |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| **c** | **Tools and Equipment** | | | |
|  | Vernier calipers | Half division | 25 | 1:1 |
|  | Micrometer screw gauge | Accuracy of 0.01mm | 25 | 1:1 |
|  | Tape measure | 5m | 25 | 1:1 |
|  | Pressure gauge | 20psi | 5 | 1:5 |
|  | Barometer | Mercury | 5 | 1:5 |
|  | Bunsen burner | 500g | 25 | 1:1 |
|  | Ripple tank | Perspex cover | 5 | 1:5 |
|  | Meter rule | Wooden | 25 | 1:1 |
|  | Slinky Spring | 1m | 25 | 1:1 |
|  | Resonance tube | Complete kit | 10 | 2:5 |
|  | Tuning forks | 2 harmonics | 25 | 1:1 |
|  | Sonometer | 20 KHz | 25 | 1:1 |
|  | Mirror | Plain and curved | 25 | 1:1 |
|  | Lenses | Perspex | 25 | 1:1 |
|  | Glass block | Rectangular | 25 | 1:1 |
|  | Optical pins | 2 inchs | 100 | 4:1 |
|  | thermometers | -100c to 1000c | 25 | 1:1 |
|  | stopwatches | Digital | 25 | 1:1 |
|  | weighing balances | 0 to 2kg | 5 | 1:5 |
|  | calorimeters | Copper | 25 | 1:1 |
|  | ammeters | 0 to 2A | 25 | 1:1 |
|  | voltmeters | 0 to 5A | 25 | 1:1 |
|  | Variable Resistors | 0 to 100 ohms | 25 | 1:1 |
|  | Connecting wires | Wires with crocodile clips | 200 | 8:1 |
|  | Dry cells | D size | 50 | 2:1 |
|  | Galvanometer | Zero centred | 25 | 1:1 |
|  | Magnets | Bar magnets | 25 | 1:1 |
|  | Smoke cell | With glass cover | 5 | 1:5 |
|  | Beakers | 250ml | 25 | 1:1 |
|  | Potassium permanganate crystals | 500grams tin | 25grams | 1:1 |
|  | Glass tube | Clear | 25 | 1:1 |