SEC (2018)

ENGINEERING TECHNOLOGY SEC 37

SYLLABUS / LEARNING AND ASSESSMENT PROGRAMME

Contents

Introduction

The aim of this learning and assessment programme is to assist secondary schools to manage vocational programmes, specifically in the planning and implementation of the programme delivery.

This learning and assessment programme is structured into two parts, namely

Part A: General Policies

Part B: Unit Specifications

In Part A, the overall aim and objectives of the programme are explained. Important terms that will be used in the LAP (Learning and Assessment Programme) will be defined. Additionally, policies, guidelines and strategies related to assessment practices are documented in this section. Quality Assurance processes and procedures are also documented in Part A of this document.

In Part B, the detailed specification of the three units that are to be implemented are provided for each unit. The learning outcomes, together with a brief description of the unit are also stipulated. The assessment criteria for each unit, together with assessment methods that are to be applied, are presented in this part of the document.

In order to ensure effective implementation of the programme, important standards and quality assurance processes and procedures have to be adopted. Standard templates will be provided in a separate document and will be structured as presented in the table provided overleaf.

Reference	Template
A	Assignment Brief Front Sheet
A	Record of Internal Verification – Assignment Brief
A	Record of Internal Verification – Assessment Decision
A	Unit Tracking Sheet Template
QA	Internal Verification Report Templates
QA	External Verification Report Templates

Legend:

A: Assessment

QA: Quality Assurance

Part A: General Policies

A.1. Programme Aim and Objectives

The aim of the vocational programme in Engineering Technology is to provide learners with the underpinning knowledge related to the Industrial Environment. By the end of the programme, candidates are expected to apply knowledge and skills efficiently.

Upon completing this programme, learners should be able to:

1. Work safely in an engineering environment.
2. Carry out basic risk assessments.
3. Respond effectively to help persons when an incident occurs.
4. Interpret different types of documentation.
5. Take appropriate care of documentation.
6. Use tools and machinery in the appropriate manner.
7. Carry out simple tests on different materials.
8. Manufacture a PCB.
9. Conduct basic tests to identify faults on circuits.

A.2. Definitions/ Terminology

Term	Definition
Assessor	The person responsible to grade the candidates' work, issue a mark and determine the candidates' final grade.
Assessment (Continuous)	A number of tasks given to the candidate during the course; these could be an individual task or as group work.
Controlled Assessment	An assessment in the form, of an examination and conducted within a school environment. The minimum time for this assessment is 1 hour.
Learning Outcome	Learning Outcomes are statements, which describe what a qualification represents in terms of knowledge, skills and competences. The Malta Qualifications Framework (MQF) defines a learning outcome as what a learner understands and is capable of doing at the end of the learning process.
Knowledge	Knowledge refers to the understanding of basic, factual and theoretical information, which is traditionally associated with formal learning but can also be acquired from informal and non-formal learning.
Skills	Skills imply the application of acquired knowledge and understanding in different contexts. A skill may be the result of formal learning or of repetitive work in an informal setting.
Competences	Each competence is defined as a combination of knowledge and skills and is associated with the level of autonomy and responsibility that the person is expected to have at that level.
Unit Content	The unit content is the content required to be communicated and given to the candidate per learning outcome. Each learning outcome must have content related to it and this content must be delivered to give the candidates the tools to achieve that outcome.
Assessment Grading Criteria	A description of what a candidate is expected to do in order to demonstrate that a learning outcome has been achieved.
Sample of Work	A sample of work is a percentage of candidates' work gathered as a representative sample for the internal or external verifier.
Quality Assurance	To assure the standards and quality of the learning assessment programme.
Malta Qualification Framework	The Malta Qualifications Framework (MQF) provides an indication of the level of difficulty as a benchmark for a qualification, which needs to be assigned a level, and mapped to the framework. The MQF has level descriptors from Level 1 to 8. The level descriptors are useful for education and training providers as they describe the Knowledge, Skills and Competences and a set of Learning Outcomes, which indicate to the learner the end of a learning process.
Synoptic Assessment	A Synoptic Assessment can be defined as an assessment, which is designed to cover all the assessment grading criteria for a given unit.

A.3. Assessment

A.3.1. Scope

Assessment is an important element in any learning process. In order to ensure that assessment informs candidates and at the same time meets important conditions of reliability, validity and fairness, important rules and procedures must be adhered to. In particular, the assessment regulations and procedures that are explained in this section will ensure that assessments are:

- Of the required standard, quality and level
- Fair for all learners
- Valid and reliable

Each unit will be assessed by means of three assignments, one of which must be an assessment conducted within a controlled school environment. The assessment mode/type, criteria to be assessed and marks distribution are explained in Part B of the programme as part of the unit specifications.

A.3.2. Programme Grade

A cumulative percentage mark, calculated on the basis of a sum total of all the 3 units, determines the final grade of candidates/ learners. Candidates/ Learners may qualify for Grades 1, 2, 3, 4, 5, 6 and 7. The results of candidates/learners who do not obtain at least a Grade 7 shall remain unclassified.

A.3.3. Important Conditions

Candidates must obtain a minimum of 50 marks in each unit in order to obtain a grade classification.

If a candidate obtains a minimum of 50 in two units, but fails to satisfy the examiner in the remaining unit, s/he may be eligible to obtain Grade 6 or Grade 7.

If a candidate obtains less than 120 marks, his grade will be Unclassified. The same applies if a candidate does not obtain at least 50 marks in two units by the end of the programme.

A.3.4. Re-Sits

If for a given unit, the total mark gained by a candidate is less than 50 marks, s/he will be eligible to re-sit. The re-sit assessment must consist of a synoptic assessment conducted within a school-controlled environment during the same academic year. The highest possible mark that may be obtained in this case is 60 marks.

Candidates who obtained an average of 50 marks or more on completion of the three tasks for a given unit will not be eligible for a re-sit to better their original mark.

Candidates who miss the controlled assessment for a justifiable reason will be eligible to sit for the synoptic assessment and may obtain full marks. The mark obtained in this assessment will replace the controlled assessment mark. The controlled assessment must not be more than 2 hours long.

A.4. Quality Assurance

An important aspect of this programme is the quality assurance process that must be conducted throughout the implementation of the programme. Three main processes are to be conducted as stipulated in the table below.

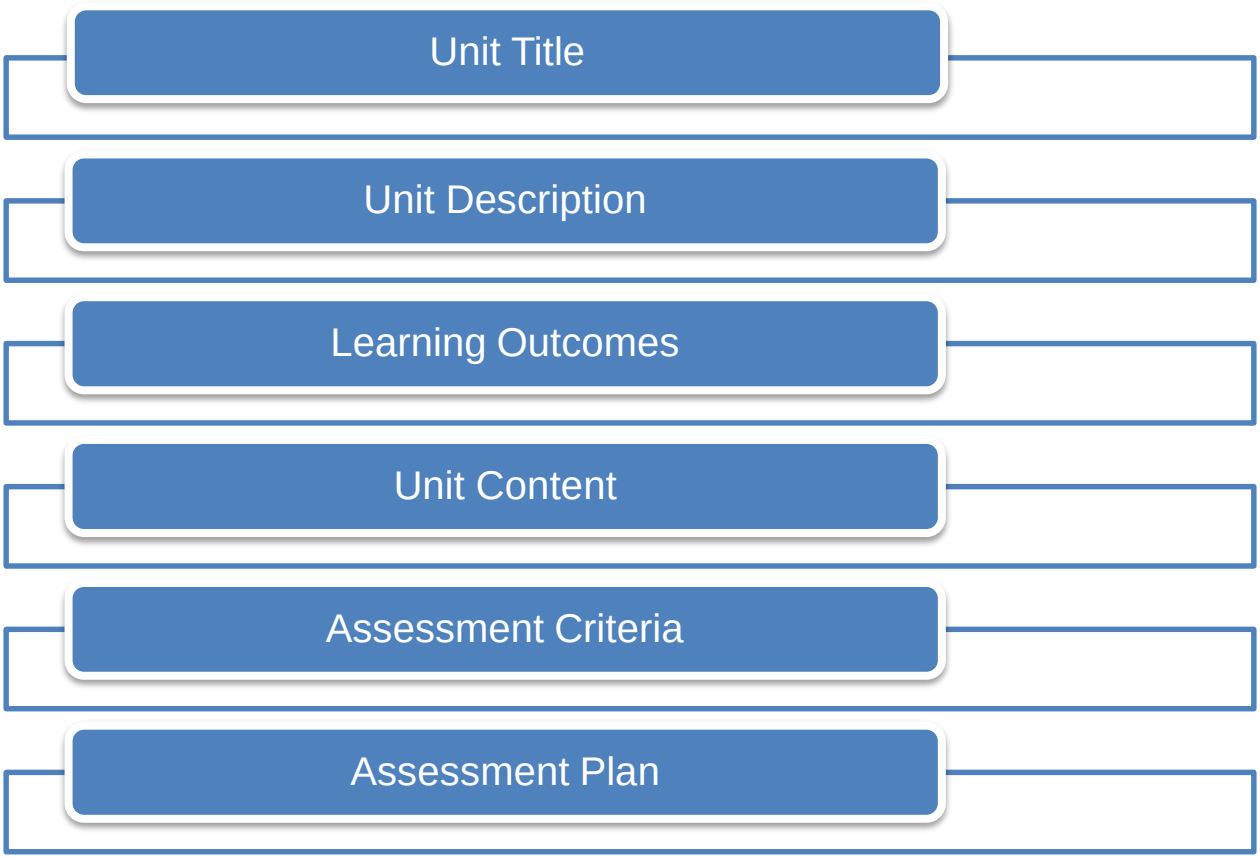
Internal Verification of Assessment Briefs	All assessment briefs are to be internally verified before being issued to the candidates. Within this process important checks relating to learning outcomes, criteria to be assessed, validated and reliability are to be performed.
Internal Verification of Assessment Decisions	Once learners complete their work and assessments have been corrected, a representative sample of learners' work is to be internally verified.
External Verification	The process of external verification will ensure that programme quality and standards criteria are met.

Part B: Unit Specifications

B.1. Introduction

This part of the programme guide provides detailed specification for each of the 3 units that are to be implemented for the successful completion of the programme. The curriculum design adopted for the development of the units of study is based on the learning outcomes approach. The latter can be defined as "written statements of what a learner should be able to do/know/apply by the end of the learning process."

The structure of the unit specifications is presented below:



B.2. Interpreting the Unit Specifications.

Under each grading criterion all the content that has to be covered can be found. Examples (e.g.), semi-colons and commas are used in the Learning and Assessment Programme. When semi-colons are used the students should be assessed on all the content prescribed. However, when the list is headed with example (e.g.), all the content is to be covered but the students are expected to be assessed on more than 50% of the content prescribed for that grading criterion.

In each grading criterion there is a command verb which specifies the level of content expected by the student, such as list, identify, outline, describe, explain etc. These verbs are defined by MATSEC in the glossary of verbs available on their website. It is of vital importance that the command verbs specified in the grading criteria remain unchanged in the assignment brief.

B.2 Unit 1: Working Effectively and Safely in an Engineering Environment.

Unit 1	Working Effectively and Safely in an Engineering Environment
Unit Description	The primary goal of the unit is to introduce safe work practices Learners will become aware of the hazards and risks associated with different tasks, working environments, uses of tools and equipment, and working with potentially dangerous materials and substances.The learner will be introduced to basic current local and EU regulations adopted for engineering workshop practices. This unit provides learners with knowledge of material and equipment handling, as well as the use and classification of appropriate personal protective equipment (PPE). The unit covers ways of avoiding hazards and ways to respond correctly and swiftly in case of an incident. The student will also have the opportunity to learn how to work with others. During this unit the students will have the opportunity to engage in engineering related activities. In order to do so students must know how to interpret and follow simple technical information. Therefore students will learn how to read drawings, symbols, abbreviations and colour codes. Moreover students will learn how to implement such information. The prolonged life of documents will also be covered.

Learning Outcomes

Upon completing the unit, learners should be able to:

LO 1. Prepare the necessary PPE's according to statuary regulations.
LO 2. Carry out basic risk assessment within an industrial environment.
LO 3. Interpret and follow basic technical documentation.

Unit Content

LO 1. Prepare the necessary PPE's according to statuary regulations.

K1- List personal and protective equipment related to engineering environment.

- Personal and Protective Equipment**:** e.g. overalls, protective foot wear, eye protection, mask/respirators, harnesses, hard hats, hand protection.

K2 - Describe the functions of PPEs for a specific task.

K3 - Identify warning signs for the nine main groups of hazardous substances.

- **Groups of hazardous signs:** gas under pressure; explosives; oxidizing; flammable; corrosive; health hazard; acute toxicity; serious health hazards; hazardous to the environment.
- **Typical hazardous substances:**
    - Gas under pressure e.g.: aerosols, oxy/acetylene, compressed air;
    - Explosives e.g.: fuels, gas cylinder, fireworks;
    - Oxidizing e.g.: bleach, sulphuric acid, nitric oxide, caustic soda;
    - Flammable e.g.: fuels, organic materials, gases;
    - Corrosive e.g.: acetic acids, hydrochloric acid, ferric chloride, sodium hydroxide;
    - Health hazard e.g.: detergents, coolant fluids, cleaning agents;
    - Acute toxicity e.g.: lead compounds, biocide, carbon monoxide;
    - Serious health hazards e.g.: petrol, lamp oil, turpentine;
    - Hazardous to the environment e.g.: mercury, diesel, turpentine.

K4 - Relate the statutory regulations to a given engineering activity.

- Local legislations e.g.
    - Act 27 of 2000 Occupational Health and Safety Authority Act,
    - Legal notice 44 of 2002 Work Place (Minimum Health and Safety Requirements) Regulations,
    - Legal notice 45 of 2002 Work Places (Provision of Health and/or Safety Signs) Regulations,
    - Legal notice 36 of 2003 General Provisions for Health and Safety at Work Places Regulations,
    - Legal notice 227 of 2003 Protection of the Health and Safety of Workers from the Risks related to Chemical Agents at Work Regulations
    - Legal notice 121 of 2003 Minimum Requirements for the use of Personal Protective Equipment at Work Regulations.
    - Legal notice 35 of 2003 Protection against Risks of Back Injury at Work Placement Regulations.

C1 – Explain the importance of using suitable packaging and labelling in relation to dangerous substances.

- Materials, places and conditions used to store dangerous substances e.g.: plastic, metal, secured cabinets, temperature conditions.

A1 – Prepare the necessary PPEs needed for an engineering task referring to local health and safety regulations.

LO 2. Carry out a basic risk assessment within an industrial environment.

K5 – Outline the various hazards that might exist in an industrial environment.

- Hazards: e.g. mechanical, electrical and electronic, physical, chemical, ergonomic, environmental.

K6 - List the key areas of a risk assessment including to whom this report should be given.

- Identify the hazards: identifying hazards that could cause risk in everyday activity;
- Decide who might be harmed and how;
- Estimate the risk: scale of risk; concept of likelihood of risk; degree of possible harm for different people;
- Controlling risks: possible actions to remove risks completely or to control them so the risk of injury is limited*;*
- Monitoring effectiveness of controls: instructions for controlling risks; implementing controls; regular review of risks and controls;
- Record Keeping
- Review risk assessment
- Persons: Health and Safety Officer; Employer.

K 7 - Describe the necessary procedures when particular incidents occur in a workshop.

- Personal Incidents:- e.g. Cuts/wounds, electric shock, unconsciousness, physical/chemical burns, sprains and strains, fractures, foreign object in the eye.
- Fire:-
    - Classes of fires;
    - Different types of fire extinguishing devices e.g.: fire blanket, different types of fire extinguishers.

C2 - Explain risks in terms of the hazards present in an engineering environment.

- Risks: Damage to equipment; harm to self; harm to others.

C 3 Explain preventative measures required for maintaining a safe work environment. Preventative Measures:

- Mechanical: e.g. wear the appropriate PPE, use the suitable tool for the proper job, visual inspection of the tool, work to laid down procedures, do not remove or disable guards, do not remove safety devices on machinery;
- Electrical and electronic: e.g. wear the appropriate PPE, check for wear on electrical cords, check appropriate fuse rating;
- Physical: e.g. wear the appropriate PPE, do not wear jewellery, tie loose hair, remove loose clothing, proper ventilation, use sunblock in direct sunlight;
- Chemical: e.g. wear the appropriate PPE, protect from direct sun light, obtain special instructions before use, do not spray on an open flame, wash thoroughly after handling, store chemicals in a safe place, report and do not use unlabelled containers;
- Ergonomic e.g. adjust workstations, proper lifting techniques, adopt good posture, avoid repetitive work movements, take frequent breaks, use appropriate tools to enable neutral posture;
- Environment e.g. permit to work, inspection of site dangers, hand rails, make sure that scaffolds are certified, do not touch bare conductors, good housekeeping, follow signs, adhere to symbols and colour codes, good ventilation, follow lock out-tag out procedures;

A2 – Carry out a basic risk assessment before engaging in an engineering activity.

LO 3. Interpret and follow basic technical documentation.

K8: Distinguish between different technical information.

- Technical Information:
  - Block diagrams; flow charts;
  - Exploded views;
  - Schematic diagram: component drawing; circuit drawing;
  - Assembly diagrams: general assembly; sub-assembly; fabrication assembly; repair and maintenance diagram.

K9:- Identify mechanical colour codes, symbols and abbreviations from given documentation.

- Symbols, Abbreviations and colour codes:
  - Mechanical Colour Codes
    - Colour Codes:
      - Industrial Cylinder Colours e.g. oxygen, acetylene, nitrogen, helium, argon, carbon dioxide;
      - Pipe Marking: e.g. drinking, chill, cold, hot, fire extinguishing, sea untreated, hydraulic, diesel fuel, compressed air, drainage, steam;
  - Mechanical symbols and abbreviations:-
    - Metals e.g. cast iron, mild steel, stainless steel, aluminium, lead, copper;
    - Welding e.g. spot weld, square butt weld, fillet weld;
    - Linear and geometric e.g. radius, diameter, projection, straight line, dashed lines, centre line, hidden lines, construction lines.

K10:- Identify electrical colour codes, symbols and SI units from given documentation.

- Symbols, Abbreviations and colour codes:
  - Electrical and electronic colour codes:- flexible cords used for direct current; resistors.
  - Electrical and electronic symbols and SI units:-
    - Electrical terms e.g. voltage, current, power, resistance, capacitance, inductance.
    - Passive components: e.g. Resistor, capacitor, inductor.
    - Semiconductors: e.g. Diodes and LEDs, operational amplifiers, transistors and MOSFETS.
    - Sensors: e.g. Light dependent resistor LDR, thermistor, microphone.
    - Actuators: e.g. D.C. motors, relays, buzzer.
    - Integrated circuits: e.g. Logic gates (AND, OR, NOT), NE555, voltage regulators.
    - Sources: e.g. Batteries, power supplies, solar cells.
    - Switches: e.g. SPST, SPDT, DPDT.

C4:-Discuss the need for reading and interpreting technical information accurately.

- Need for reading and interpreting technical information: Work to laid down procedures; produce accurately the required task; health and safety reasons; to safeguard the equipment being used; communicate ideas to others; priority setting.

C 5 - Explain measures needed in order to properly store and re-use documentation.

- Types of documentation: e.g. manuals, data sheets, job cards, test schedules, quality control documentation, work permits, injury reports, risk assessments.
- Document care and control:
  - Location and security e.g. appropriate storage conditions, access point procedures, return procedures, reporting discrepancies in data and documents;
  - Physical handling e.g. damage and effects from graffiti, damage and effects from normal usage, cleanliness, folding methods;
  - Document control e.g. issue dates, amendment dates, reporting of loss/damage.
- Legislation:- Data protection.

A3: Carry out an assembly task from given engineering information.

Assessment Criteria

Assessment criteria provide guidance on how the learners will be assessed in order to ensure that the learning outcome has been achieved. To achieve each outcome a learner must satisfy the following assessment criteria grid. The assessment criteria which will be assessed in the controlled assessment have been highlighted.

Learning Outcomes	Knowledge	Comprehension	Application
LO 1	K-1 List personal and protective equipment related to engineering environment. K-2 Describe the functions of PPEs for a specific task. K-3 Identify warning signs for the nine main groups of hazardous substances. K-4 Relate the statutory regulations to a given engineering activity.	C-1 Explain the importance of using suitable packaging and labelling in relation to dangerous substances.	A-1 Prepare the necessary PPEs needed for an engineering task referring to local health and safety regulations.
LO 2	K-5 Outline the various hazards that might exist in an industrial environment. K-6 List the key areas of a risk assessment including to whom this report should be given. K-7 Describe the necessary procedures when particular incidents occur in a workshop.	C-2 Explain risks in terms of the hazards present an engineering environment. C-3 Explain preventive measures required for maintaining a safe work environment.	A-2 Carry out a basic risk assessment before engaging in an engineering activity.
LO 3	K-8 Distinguish between different technical information. K-9 Identify mechanical colour codes, symbols and abbreviations from given documentation. K-10 Identify electrical colour codes, symbols and abbreviations from given documentation.	C-4 Discuss the need for reading and interpreting technical information accurately. C-5 Explain measures needed in order to properly store and re-use documentation.	A-3 Carry out an assembly task from given engineering information.

Assessment criteria – Marking scheme

4 marks are to be allocated for each knowledge assessment criteria (K1 to K10), for a total of 40 marks.
6 marks are to be allocated for each comprehension assessment criteria (C1 to C5), for a total of 30 marks.
10 marks are to be allocated for each application assessment criteria (A1 to A3), for a total of 30 marks.

Ass. No.	Assessment Mode	Percentage distribution
1	Assignment 1	26 - 34%
2	Assignment 2	26 - 34%
3	Controlled	38 - 42%

Resources

Workshop facility is essential for the delivery of guided training in basic vocational engineering tasks. Basic set of equipment, hand and power tools are needed. All PPE must be available to be used by every single learner during demonstration, practice and assessment.

Additional Notes

a) When teaching K9 teachers should refer to the British standards mainly:
   1. BS1710 Pipe identification guide;
   2. BS EN 1089-3 Gas cylinder identification guide;
   3. British Weld Symbols BS EN 22553.

b) The following Metal abbreviations should be used:-

CI - cast iron
MS - mild steel
SS - stainless steel
Al - aluminium
PB - lead
CU- copper

B.3 Unit 2: Using Tools and Materials

Unit 2	Using Tools and Materials
Unit Description	This unit exposes the learner to knowledge about common materials used in industry such as wood, metals, plastics and smart materials. By succeeding through this unit the learner will be able to differentiate between materials and comprehend some of their properties. The learner will also gain knowledge about the most common processes used to work and form such materials for the industrial market. Consequently, learners will learn how to make use of a variety of hand and power tools to work the materials mentioned, whilst also becoming aware of how to maintain some of the tools.

Learning Outcomes

Upon completion of this unit, the learner will be able to:

LO 1. Understand the properties of different types of materials and manufacturing processes.

LO 2. Carry out tests to identify materials for specific needs.

LO 3. Choose the appropriate form in which a material is supplied to manufacture an engineering component.

LO 4. Make use of different tools safely and appropriately to produce an engineering component.

Unit Content

LO 1. Understand the properties of different types of materials and manufacturing processes.

K-1 Describe the difference between metals.

- Ferrous metals:
    - Material: steel e.g. mild steel, carbon steel, wrought iron;
- Non-ferrous metals:
    - Material: e.g. aluminium, copper, lead;
- Alloys:
    - Ferrous alloys: e.g. nickel, cast iron, stainless steel;
    - Nonferrous alloys: e.g. brass, duralumin, solder.
- Differences:
    - Ferrous metals: contain iron; harder than nonferrous material; rust;
    - Non-ferrous metals: can be used to protect ferrous materials; protection against elements; corrosion;
    - Alloys: mixture of ferrous and non-ferrous material; mixture according to industry needs.

K-2 Describe the difference between woods.

- Hard wood:
    - Material: e.g. mahogany, oak, balsa wood, beech, walnut, cherry;
- Soft wood:
    - Material: e.g. pine, juniper;
- Manufactured wood:
    - Material: e.g. veneered, chipboard, plywood, block board, medium density fibreboard, oriented strand board.
- Differences:
    - Hard wood: loose leaves during the cold wood; broad leaves;
    - Soft wood: ever-green trees; needle leaves; cheaper in price than hard wood; faster growth rate;
    - Manufactured wood: can be manufactured according to industry needs; made from recycled natural wood; cheaper in price than natural wood; does not have live characteristics as natural wood.

K- 3 Describe the difference between polymers.

- Thermosetting polymers:
    - Material: e.g. polyurethane, polyesters, vulcanized rubber, Bakelite, epoxy resin, melamine, silicones;
- Thermoplastic polymers:
    - Material: e.g. polyethylene, polypropylene, polystyrene, acrylic, ABS, PET, PVC.
- Differences:
    - Thermosetting polymers: e.g. once set cannot be reset, during manufacturing these transform from liquid to solid, if exposed to heat these materials degrade rather than melt;

- Thermoplastic polymers: e.g. once heated to the ideal temperature can be reset, during manufacturing these transform from granules or powders to the actual object with the help of heat.

K-4 Describe the function and types of smart material.

- Types of smart materials: piezoelectric; shape memory alloys/polymers; magnetic shape memory; self-healing material.
- Function: have one or more properties that can be significantly changed by certain conditions such as: stress, temperature, moisture, pH, electric or magnetic fields.

C-1 Explain the properties of different materials needed for particular applications.

- Properties: e.g. hardness, ductility, malleability, resistance to environmental degradation, strength, elasticity.

C-2 Explain the different manufacturing processes of different materials.

- Processes:
  - Metal Processes: Annealing; hardening; galvanizing; electroplating.
  - Wood Processes: seasoning; wood joints; bending; finishing.
  - Polymers:
    - Thermoplastic processes: e.g. vacuum forming, line bending, injection moulding, blow moulding, rotational forming,
    - Thermosetting processes: casting.

LO 2. Carry out tests to identify materials for specific needs.

K-5 Outline the different tests that can be carried out on materials.

- Different tests: hardness; tensile; compression; shear; temperature; torque; impact; environmental degradation.

C-3 Justify the test that needs to be conducted on given materials for a particular scenario.

A-1 Carry out different tests in order to select a suitable material according to a given scenario.

L0 3 Choose the appropriate form in which a material is supplied to manufacture an engineering component.

K- 6 Identify the forms of supply available for engineering materials.

Forms of Supply:

- Metals: bar; sheet; pipe/rod; wire; castings; forgings; mouldings; extrusions; powders;
- Woods: planks; sheets; dowels; mouldings; beams;
- Polymers: film/sheets; pellets/ powders; extrusions; castings; pipe/rod; liquid.

C-4 Justify the appropriate forms of supply of different materials for given engineering components.

LO 4. Make use of different tools safely and appropriately to produce an engineering component.

K- 7 Outline the functions of different measuring and marking out tools.

- Marking out tools: e.g. scriber, centre punch, chalk line, dividers/callipers, surface plate, trammel, blueing or paint, scribing block, mortise gauge;
- Measuring tools: e.g. ruler, measuring tape, protractor, gauges, Vernier calliper, micrometre, engineer square, sliding bevel, combination sets.

K-8 Outline the functions of different hand tools.

- Hand tools: hammers/mallets; pincers; pliers; saws; screwdrivers; files; spanners and sockets; chisels; planer; taps and dies.

K-9 Outline the functions of different power tools and machinery.

- Power tools and machinery: drills; lathe; sanding machines; band saw; strip wire heater; hot air blowers; vacuum former; angle grinder; cross cut; jigsaw/scroll saw.

K- 10 Describe the appropriate use, maintenance and care of different tools.

- Different tools: marking out tools; measuring tools; hand tools; power and machinery tools.

C-5 Justify the choice of tools to be used to manufacture a particular engineering component.

A-2 Use tools to carry out a measuring and marking out activity on sheet material from given information.

A-3 Use different tools appropriately to produce a simple 3D engineering component from given information.

Assessment Criteria

Assessment criteria provide guidance on how the students will be assessed in order to ensure that the learning outcome has been achieved. To achieve each outcome a learner must satisfy the following assessment criteria. The assessment criteria which will be assessed in the controlled assessment have been highlighted.

Learning Outcomes	Knowledge	Comprehension	Application
LO 1	K-1 Describe the difference between metals. K-2 Describe the difference between woods. K- 3 Describe the difference between polymers. K-4 Describe the function and types of smart material.	C-1 Explain the properties of different materials needed for particular applications. C-2 Explain the different manufacturing processes of different materials.	
LO 2	K-5 Outline the different tests that can be carried out on materials.	C-3 Justify the test that needs to be conducted in order to select an appropriate material for a particular scenario.	A-1 Carry out tests in order to select a suitable material according to a given scenario.
L0 3	K- 6 Identify the forms of supply available for engineering materials.	C-4 Justify the appropriate forms of supply of different materials for given engineering components.	
LO 4	K- 7 Outline the functions of different measuring and marking out tools. K-8 Outline the functions of different hand tools. K-9 Outline the functions of different power tools and machinery. K- 10 Describe the appropriate use, maintenance and care of different tools.	C-5 Justify the choice of tools to be used to manufacture a particular engineering component.	A-2 Use tools to carry out a measuring and marking out activity on sheet material from given information. A-3 Use different tools appropriately to produce a simple 3D engineering component from given information

Assessment criteria – Marking scheme

4 marks are to be allocated for each knowledge assessment criteria (K1 to K10), for a total of 40 marks.
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Resources

Workshop facility is essential for the delivery of guided training in basic vocational engineering tasks. Basic set of equipment, hand and power tools are needed. All PPE must be available to be used by every single student during demonstrating, practice and assessment.

B.4 Unit 3: Electronic Circuits Designs

Unit 4	Electronic Circuits Designs
Unit Description	This unit equips the learner with a skill set of theoretical and practical knowledge relating to the domains of electrical and electronic circuits. By succeeding through this unit, the learner will be able to read and interpret circuit diagrams while being aware of how different electrical and electronic components interact so that a circuit achieves a desired function. The learner will be able to assemble and test simple circuits on prototype boards such as a breadboard and a strip board, and also manufacture a printed circuit board.

Learning Outcomes

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

LO 1. Interpret the different representations of simple circuits.

LO 2. Test and find faults in simple circuits.

LO 3. Construct simple electronic circuits.

Unit Content

LO1. Interpret the different representations of simple circuits.

K-1.Identify different electronic components from their schematic, pictorial and real life representation.

- Different electronic components:
  - Passive components: e.g. Resistor, capacitor, inductor;
  - Semiconductors: e.g. Diodes and LEDs, operational amplifiers, transistors and MOSFETS;
  - Sensors: e.g. Light dependent resistor LDR, thermistor, microphone;
  - Actuators: e.g. D.C. motors, relays, buzzer;
  - Integrated circuits: e.g. Logic gates (AND, OR, NOT), NE555, voltage regulators;
  - Sources: e.g. Batteries, power supplies, solar cells;
  - Switches: e.g. SPST, SPDT, DPDT;
  - Connectors: e.g. BNC, IC base, screw-type and spring-type PCB connectors.

K-2.Identify sub-circuits from their schematic, pictorial and real life representation.

- Sub-circuits: Potential divider; bridge network; timing circuits; gain/attenuation block.

K-3. Classify components into categories.

K-4. Predict the value of components in a circuit by using basic laws of electricity.

- Basic laws of electricity: V=IR; P=IV; Resistors and capacitors in parallel and series; T=RC.

C-1. Describe the behaviour of individual components

- Individual Components: resistor; LDR; capacitor; diode; operational amplifier; transistor; relay; motor; logic gates; battery; solar cell; SPDT.

C-2. Interpret characteristic curves of individual components.

- Individual components: resistors; diodes; transistors.

C-3. Discuss the function of a sub circuit in relation to the characteristics of its individual components.

- Sub-circuits: e.g. Potential divider, bridge network, timing circuits, gain/attenuation block.

A-1.Translate a schematic diagram of a circuit to its prototype equivalent both pictorially and physically.

One of the following circuits: Amplifiers, Timers or Oscillators, Filters, Sensing circuits, Actuating circuits, Audio or Visual indicator circuits.

LO 2. Test and find faults in simple circuits.

K-5. Identify tools and equipment used to construct circuits.

- Tools and equipment: soldering iron; wire stripper; side cutter; long nose pliers; third hand; de-soldering pump; solder wick; track cutter.

K-6. Label test bench equipment and settings.

- Test Bench Equipment: Multi-meter; oscilloscope; signal generator.

K-7 Describe basic voltage, current and resistance tests.

C-4. Justify the use of test bench equipment in relation to differrent scenarios.

A-2. Fault find a circuit using a multi-meter.

- Faults: e.g. Missing or misplaced or incorrect components, missing jumpers or footprint pads, miscalculated components or misoriented components.

LO3. Construct simple electronic circuits.

K-8. Identify different electronic boards and their parts.

- Electronic boards: Breadboard; strip board; PCB.
- Parts: bus lines; terminal strips; copper tracks; insulation layer; photo resist layer.

K-9. Describe the process of constructing a printed circuit board.

- Process: Drawing of the artwork (with or without software); chemical development of PCB; etching of a PCB; populating the PCB.

K-10. Describe the soldering processes for prototypes and mass produced circuits.

- Soldering processes for prototypes: cleaning of soldering iron tip and board; preparation of surfaces to be soldered by tinning; applying solder; finishing
- Soldering processes for mass produced circuits: Silk screening; surface mount components; soldering baths; robotic assembly.

C-5. Identify the advantages and disadvantages of electronic boards.

- Electronic boards: Breadboard; strip board; PCB.

A-3. Manufacture a printed circuit board using the chemical process.

- Manufacturing: Drawing of the artwork (with or without software); safe handling of chemicals using the appropriate PPEs and procedures; chemical development; etching of a PCB; populating the PCB.

Assessment Criteria

Assessment criteria provide guidance on how the learners will be assessed in order to ensure that the learning outcome has been achieved. To achieve each outcome a learner must satisfy the following assessment criteria. The assessment criteria which will be assessed in the controlled assessment have been highlighted.

Learning Outcomes	Knowledge	Comprehension	Application
LO 1.	K-1.Identify different electronic components from their schematic, pictorial and real life representation. K-2.Identify sub-circuits from their schematic, pictorial and real life representation. K-3. Classify components into categories. K-4. Predict the value of components in a circuit by using basic laws of electricity.	C-1. Describe the behaviour of individual components. C-2. Interpret characteristic curves of individual components. C-3. Discuss the function of a sub circuit in relation to the characteristics of its individual components.	A-1.Translate a schematic diagram of a circuit to its prototype equivalent both pictorially and physically.
LO 2.	K-5. Identify tools and equipment used to construct circuits. K-6. Label test bench equipment and settings. K-7 Describe basic voltage, current and resistance tests.	C-4. Justify the use of test bench equipment in relation to different scenarios.	A-2. Fault find a circuit using a multi-meter.
LO 3.	K-8. Identify different electronic boards and their parts. K-9. Describe the process of constructing a printed circuit board. K-10. Describe the soldering processes for prototypes and mass produced circuits.	C-5. Identify the advantages and disadvantages of electronic boards.	A-3. Manufacture a printed circuit board using the chemical process.

Assessment criteria – Marking scheme

4 marks are to be allocated for each knowledge assessment criteria (K1 to K10), for a total of 40 marks.
6 marks are to be allocated for each comprehension assessment criteria (C1 to C5), for a total of 30 marks.
10 marks are to be allocated for each application assessment criteria (A1 to A3), for a total of 30 marks.

Ass. No.	Assessment Mode	Percentage distribution
1	Assignment 1	26 - 34%
2	Assignment 2	26 - 34%
3	Controlled	38 - 42%

Resources

Workshop facility is essential for the delivery of guided training on basic vocational engineering tasks. Basic set of equipment, hand and power tools are needed. All PPE must be available to be used by every single learner during demonstrating, practice and assessment.

Appendix 1 – Suggested Resources

This list is not intended to be exhaustive but should be taken as a guide.

Per workshop:

Marking out tools: chalk line; surface plate; trammel; blueing or paint; scribing block; mortise gauge;

Measuring tools: micrometre; gauges;

Power tools and machinery:

- Materials: lathe, sanding machines; band saw; strip wire heater; vacuum former; angle grinder; cross cut; scroll saw
- Electronics: UV box; etching tank;

Test Bench Equipment: oscilloscope; signal generator;

Per group of 2 students

Benches: Wood working benches; metal working benches;

Per student

Measuring tools: ruler

Hand tools: (electronics): soldering iron; wire stripper; side cutter; long nose pliers; third hand;

Per group of 2-4 students:

Marking out tools: Scriber; centre punch; dividers/callipers;

Measuring tools: measuring tape; protractor; veneer calliper; engineer square; sliding bevel; combination sets;

Hand tools:

- Materials: hammers/mallets; pincers; pliers; saws; screwdrivers; files; spanners; sockets; chisels; planer; taps; dies,
- Electronics: de-soldering pump track cutter;

Power tools and machinery: drills; hot air blowers; jigsaw;

Test Bench Equipment: Multi-meter.