



L-Università
ta' Malta

MATSEC
Examinations Board



SEC 37 Syllabus

Engineering Technology

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Introduction

This syllabus is based on the curriculum principles outlined in *The National Curriculum Framework for All* (NCF) which was translated into law in 2012 and designed using the *Learning Outcomes Framework* that identify what students should know and be able to achieve by the end of their compulsory education.

As a learning outcomes-based syllabus, it addresses the holistic development of all learners and advocates a quality education for all as part of a coherent strategy for lifelong learning. It ensures that all children can obtain the necessary skills and attitudes to be future active citizens and to succeed at work in society irrespective of socio-economic, cultural, racial, ethnic, religious, gender and sexual status. This syllabus provides equitable opportunities for all learners to achieve educational outcomes at the end of their schooling which will enable them to participate in lifelong and adult learning, reduce the high incidence of early school leaving, and ensure that all learners attain key twenty-first century competences.

This programme also embeds learning outcomes related to cross-curricular themes, namely digital literacy; diversity; entrepreneurship creativity and innovation; sustainable development; learning to learn; and cooperative learning and literacy. This way students will be fully equipped with the skills, knowledge, attitudes and values needed to further learning, work, life and citizenship.

The aim of the vocational programme in Engineering Technology is to provide students with the underpinning knowledge related to the Engineering Technology industry. By the end of the programme, students are expected to have gained sufficient skills and knowledge and be able to apply them.

Programme Learning Outcomes

At the end of the programme, I can:

- Work safely in an engineering environment.
- Carry out basic risk assessments.
- Respond effectively to help persons when an incident occurs.
- Interpret different types of documentation.
- Use tools and machinery in the appropriate manner.
- Carry out simple tests on different materials.
- Manufacture a PCB.
- Construct an electro-mechanical project using tools and machinery.
- Conduct basic tests to identify faults.

Unit Learning Outcomes

Unit 1: Using Tools and Materials

At the end of the unit, I can:

- LO 1.** Prepare the necessary PPE according to statutory regulations.
- LO 2.** Demonstrate an understanding of the properties of different types of materials and manufacturing processes.
- LO 3.** Make use of measuring and marking out tools.
- LO 4.** Make use of different tools safely and appropriately to produce an engineering component.
- LO 5.** Finish a given product to given specifications.

Unit 2: Electronic Circuits Designs

At the end of the unit, I can:

- LO 6.** Demonstrate an understanding of voltage, current and resistance.
- LO 7.** Recognize basic circuit structures.
- LO 8.** Demonstrate knowledge of capacitors and resistors in timing circuits.
- LO 9.** Use semi-conductors and integrated circuits.
- LO 10.** Construct and test digital and analogue circuits safely and effectively.

Unit 3: Electro-mechanical Systems

At the end of the unit, I can:

- LO 11.** Demonstrate knowledge of alternating current and coils.
- LO 12.** Demonstrate an understanding of power tools and their individual mechanical components.
- LO 13.** Demonstrate knowledge of emergency procedures.
- LO 14.** Construct an electro-mechanical product using power tools from given documentation.

Programme Level Descriptors

This syllabus sets out the content and assessment arrangements for the award of Secondary Education Certificate in Engineering Technology at Level 1, 2 or 3. First teaching of this programme begins in September 2024. First award certificates will be issued in 2027.

The following levels refer to the qualification levels that can be obtained by candidates sitting for SEC examinations. These are generic statements that describe the depth and complexity of each level of study required to achieve an award at Level 1, 2 or 3 in Engineering Technology. (Level 1 being the lowest and Level 3 the highest).

Level 1: At the end of the programme the candidate will have obtained basic knowledge, skills and competences in the subject such as basic repetitive communication skills and the ability to follow basic, simple instructions to complete tasks. Support is embedded within the task.

Level 2: At the end of the programme the candidate will have obtained good knowledge, skills and competence in the subject such as the interpretation of given information and ideas. The candidate will have developed the ability to carry out complex tasks. Limited support may be embedded within the task.

Level 3: At the end of the programme the candidate will autonomously apply knowledge and skills to a variety of complex tasks. Candidates will utilise critical thinking skills to analyse, evaluate and reflect upon their own work and that of others. Problem solving tasks may be part of the assessment process.

Interpreting the Syllabus

This document is an assessment syllabus. Whilst the content provided is the minimum expected for assessment purposes, the provision of further examples or information is encouraged – although not mandatory – for students to enjoy the learning process and get a better overview of the subject.

Unit Structure

The various learning outcomes, assessment criteria, and content are grouped under three units. Each unit is presented in the following structure:

- Title
- Description
- Learning Outcomes
- Assessment Criteria and Content
- Learning Outcomes and Assessment Criteria

Educators may devise their own plan for content delivery across the years of study. They may choose to follow the unit learning outcomes and content structure as presented in the syllabus, and conclude each unit by the end of every scholastic year, or follow a different order which in their professional view would be more conducive to learning of any particular subject area or topic. However, by the end of the three-year programme in Year 11, all content delivery and continuous assessment should be completed, in time for submission to MATSEC in the indicated time-frames and format.

Assessment Criteria

The active verb used in assessment criteria (such as list, identify, outline, describe, explain, etc...) indicates what candidates are expected to know or be able to do. It also provides direction with respect to expected complexity in the candidates' responses or work. These verbs are defined in the Glossary of Terms available on the MATSEC website. Application criteria are to be interpreted in terms of Bloom's taxonomy psychomotor domain.

Content

For each assessment criterion, only the minimum content that needs to be covered is listed. Examples (e.g.), commas, semi-colons, bullets, 'or', and 'N.B.' are used for presentation and guidance purposes only. While all the material reflecting both the unit content and the assessment criteria is to be delivered, this will not necessarily be assessed by MATSEC in its entirety, as indicated in the Scheme of Assessment. Where the plural is used in any assessment criterion (e.g. types, aspects, steps, etc.), two or more answers are usually expected, although this may not always be the case.

Scheme of Assessment

The assessment of this subject follows the Secondary Education Certificate Regulations and the MATSEC Assessment Code of Practice governing each respective cohort. It shall be based on three components, each of which contributes towards the overall subject mark as follows:

COMPONENT	LEVEL WEIGHT (OVERALL SUBJECT MARK)
SBA (Paper I)	30%
Coursework (Portfolio)	30%
Controlled assessment (Paper II)	40%

Candidates have to attempt all three assessment components, and fulfil the set criteria in the coursework component and Paper II, to obtain a level higher than Level 1.

Individuals may not register as private candidates in this subject, unless they are resitting the subject in a subsequent Main Session. In the latter case, marks obtained in the SBA and the coursework can be carried forward for up to five years from the first sitting.

School-based assessment (SBA)

SBA (Paper I) refers to the assessment of the application criteria specified in the syllabus, assigned to candidates and marked by school teachers. This component is unmoderated.

SBA should be set at Level 1-2-3, following a 30-30-40 percentage mark allocation, with Level 3 carrying the highest marks.

The SBA should be marked out of 100 each year (9, 10, and 11). The assessment for each year will contribute to 10% of the overall subject mark and will be reported to MATSEC by the school when the candidate is in Year 11. Therefore, each year will equally contribute to the final 30% mark of the SBA.

SBA SUBMISSION TO MATSEC IN YEAR 11			LEVEL WEIGHT (OVERALL SUBJECT MARK)
Year 9	Year 10	Year 11	30%
[0 to 100] marks	[0 to 100] marks	[0 to 100] marks	

Coursework

Coursework in this subject refers to a Portfolio, divided in three parts carried out across the three-year programme, which will be set and marked by the teacher following the templates downloadable from the MATSEC website and the marking schemes included as an appendix in the syllabus. This component is moderated.

Each coursework part will be marked out of 60 and will be set at Level 1-2-3. The assessment of each part will contribute to 10% of the overall mark and will be reported to MATSEC by the school when the candidate is in Year 11. Therefore, each part will equally contribute to the final 30% mark of coursework.

The school is to upload a digital copy of their candidates' coursework on the MATSEC portal by the date established by the MATSEC Board and ensure that all coursework is available as instructed. Candidates may be called for an interview in relation to their coursework.

Candidates are to fulfil the set criteria in this assessment component to obtain a level higher than Level 1.

COURSEWORK SUBMISSION TO MATSEC IN YEAR 11 FOR MODERATION			LEVEL WEIGHT (OVERALL SUBJECT MARK)
Part 1	Part 2	Part 3	30%
Based on any TWO application criteria from Unit 1	Based on any TWO application criteria from Unit 2	Based on any ONE application criterion from Unit 3 and a Self-Evaluation	
[0 to 60] marks	[0 to 60] marks	[0 to 60] marks	

Controlled Assessment

The controlled assessment (Paper II) comprises a two-hour written exam set and marked by MATSEC at the end of the three-year programme.

The paper will carry a total of 100 marks and will be set at Level 1-2-3. It will include questions based on a number of knowledge or comprehension criteria from different units, learning outcomes and levels.

Attainment in this component will be reported by MATSEC as a Grade using an 8-point scale and will contribute towards 40% of the marks in determining the overall level.

Candidates are to fulfil the set criteria in this assessment component to obtain a level higher than Level 1.

CONTROLLED ASSESSMENT IN YEAR 11	LEVEL WEIGHT (OVERALL SUBJECT MARK)
Two-hour exam paper	40%
[0 to 100] marks	

Unit 1: Using Tools and Materials

Unit Description

This unit exposes the candidate to knowledge about common materials used in industry such as wood, metals and plastics. After completing this unit the candidate will be able to differentiate between materials and comprehend some of their properties.

The candidate will also gain knowledge about the most common processes used to work and form such materials for the industrial market. Consequently, they will learn how to make use of a variety of hand and power tools to work the mentioned materials, whilst also becoming aware of ways in which such tools could be maintained.

Learning Outcomes

At the end of the unit, I can:

- LO 1.** Prepare the necessary PPE according to statutory regulations.
- LO 2.** Demonstrate an understanding of the properties of different types of materials and manufacturing processes.
- LO 3.** Make use of measuring and marking out tools.
- LO 4.** Make use of different tools safely and appropriately to produce an engineering component.
- LO 5.** Finish a given product to given specifications.

Assessment Criteria and Content

Subject Focus	Health and Safety		
LO 1.	Prepare the necessary PPE according to statutory regulations.		
K-1.	K-1. Identify personal protective equipment.	K-1. List personal protective equipment related to a given task/s.	K-1. Describe the functions of PPEs related to a given task/s.
	Personal Protective Equipment: e.g. overalls, protective footwear, eye protection, masks/respirators, harnesses, hard hats, hand protection.		
K-2.	K-2. Match safety sign colours with their purpose.	K-2. Name the given safety signs.	K-2. Identify suitable safety signs for a given scenario.
	Purpose of safety sign colours: <ul style="list-style-type: none"> • Red signs: prohibition or danger or firefighting equipment; • Yellow signs: warning; • Blue signs: mandatory; • Green signs: no danger or emergency escape or first aid. Safety signs: e.g. no smoking, not drinkable, no access for pedestrians, no access for unauthorised persons, fire extinguisher, do not extinguish with water, flammable material, toxic material, overhead load, industrial vehicles, danger of electrocution, general danger, safety overalls must be worn, safety helmet must be worn, eye protection must be worn, face protection must be worn, emergency exit, first aid, eyewash. N.B. It is highly recommended that during delivery reference should be made to Subsidiary Legislation 424.16.		
K-3.	K-3. Match the responsibilities of the employer and the employees established by the Occupational Health and Safety Authority Act.	K-3. Assign given Health and Safety legislation to given scenarios.	K-3. Describe responsibilities in relation to Health and Safety legislation for a given incident.
	Responsibilities of employers and employees according to Act 27 of 2000 Occupational Health and Safety Authority Act: <ul style="list-style-type: none"> • Employers should provide: a safe system of work; a safe and healthy workplace; safe work equipment; safe methods of storing, transporting, and handling; means to suitably dispose of substances and materials; means to suitably handle substances and material; competent properly-trained supervisor; • Employees: cooperate with employers in all matters regarding health and safety; not put oneself and other people at risk; not to misuse or interfere with anything relating to health and safety; to report defects or dangerous situations that you find in the workplace; to work safely following instruction and training. 		

	<p>Health and Safety legislation: e.g.</p> <ul style="list-style-type: none"> • 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. 		
	<p>Incidents: injury leading to temporary/permanent disability or damages to tools/equipment/machinery.</p> <p>N.B. For assessment purposes at Level 3, reference to the specific legislation is not required.</p>		
C-1.	C-1. Explain the consequences of not using the appropriate design and material of PPE for a specific activity.	C-1. Explain why given PPEs can have a different functional design or material.	C-1. Explain the choice of PPE with specific design and material for a given scenario.
	<p>Consequences of not using PPE: e.g. minor injury, suffer a serious life changing injury or illness as the result of an accident at work, worker could be killed.</p>		
	<p>N.B. For assessment purposes in relation to material, only the generic type of material is expected (e.g. rubber) rather than the specific type (e.g. silicone).</p>		
	<p>Choice of PPE for a given scenario: working at heights or working in confined spaces or handling hazardous chemicals or hot working or working on electrical equipment or working with machine tools or construction work or electrical installation.</p>		

Subject Focus	Materials		
LO 2.	Demonstrate an understanding of the properties of different types of materials and manufacturing processes.		
K-4.	K-4. Identify the different forms of supply of metal.	K-4. List different properties of metals.	K-4. Explain why a particular form of supply and type of metal should be used for a given scenario.
	Forms of supply of metal: e.g. bar, sheet, pipe, rod, wire, castings, forgings, mouldings, extrusions.		
	Properties of metals: e.g. hardness, ductility, malleability, resistance to environment degradation, strength, elasticity.		
	Type of metal: mild steel or carbon steel or wrought iron or aluminium or lead or copper or carbon steel or cast iron or stainless steel or brass or duralumin or solder. <i>N.B. It is highly recommended that reference is made to ferrous metals, non-ferrous metals, ferrous alloys and non-ferrous alloys.</i>		
K-5.	K-5. Identify the different forms of supply of wood.	K-5. List different properties of wood.	K-5. Explain why a particular form of supply and type of wood should be used for a given scenario.
	Forms of supply of wood: planks; sheets; dowels; mouldings; beams.		
	Properties of different woods: strength; toughness; hardness; wear resistance; resistance to environment degradation.		
	Type of wood: mahogany or oak or balsa wood or beech or walnut or cherry or pine or red deal. <i>N.B. It is highly recommended that reference is made to hardwood, softwood and manufactured wood.</i>		
K-6.	K-6. Identify the different forms of supply of polymers.	K-6. List different properties of polymers.	K-6. Explain why a particular form of supply and type of polymer should be used for a given scenario.
	Forms of supply of polymers: e.g. film/sheet, pellets/powder, extrusions, castings, pipe/rod, liquid.		
	Properties of different polymers: e.g. hardness, ductility, malleability, resistance to environment degradation, strength, elasticity.		
	Type of polymer: polyurethane or polyester or vulcanised rubber or Bakelite or epoxy resin or melamine or silicones or polyethylene or polypropylene or polystyrene or acrylic or ABS or PET or PVC. <i>N.B. It is highly recommended that reference is made to thermosetting and thermoplastic polymers.</i>		

C-2.	C-2. Outline the different tests that can be carried out on materials.	C-2. Describe the test used to examine a particular material property.	C-2. Explain which test is required to determine the suitability of a given material for a given scenario.
	Different tests: e.g. hardness, tensile, compression, shear, temperature, torque, impact, environment degradation.		
C-3.	C-3. Outline manufacturing processes of particular materials.	C-3. Describe the result obtained after applying manufacturing processes on particular materials.	C-3. Justify suitable manufacturing processes for a given scenario/s.
	Manufacturing processes: e.g. <ul style="list-style-type: none"> • Metal processes: annealing; hardening; galvanising; electroplating, • Wood processes: seasoning; wood joining; bending; finishing, • Polymers: vacuum forming; line bending; moulding; rotational forming; casting. 		

Subject Focus	Measuring and marking out tools		
LO 3.	Make use of measuring and marking out tools.		
K-7.	K-7. Identify different measuring and marking out tools.	K-7. Outline the functions of different measuring and marking out tools.	K-7. Choose the appropriate measuring and marking out tools for a specific task/s.
	Measuring and marking out tools: <ul style="list-style-type: none"> • Measuring tools: e.g. steel ruler, measuring tape, protractor, height gauge, Vernier calliper, micrometre, engineering/try square, sliding bevel, combination square; • Marking out tools: e.g. scribe/marking knife, centre punch, chalk line, dividers/ callipers, surface plate, blueing or paint, scribing block, mortise gauge, centre square. 		
A-1.	A-1. Prepare the necessary PPE, measuring and marking out tools and materials from a given engineering drawing.	A-1. Use measuring and marking out tools in the appropriate manner.	A-1. Carry out the necessary measurements and markings to a given tolerance.
	Preparation: PPE; marking out tools; materials.		
	Using measuring and marking out tools: proper use of measuring tools; handling of marking out tools; good housekeeping; teamwork.		
	Carrying out the necessary measurements: accuracy and precision (tolerance of 0.5mm); clear markings.		

Subject Focus	Cutting, drilling, bending, forming and joining processes		
LO 4.	Make use of different tools safely and appropriately to produce an engineering component.		
K-8.	K-8. Name different cutting and drilling tools.	K-8. Relate the appropriate cutting and drilling tools to a specific task.	K-8. Describe preventive measures to be taken when using cutting and drilling tools.
	Drilling and cutting tools: e.g. saws/hack saw, milling machine, lathe, angle grinder, band saw/engineers band saw, circular saw, jigsaw/scroll saw, taps and dies, drill.		
	Preventive measures: e.g. wear appropriate PPE, use 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 or disable safety devices on machinery, do not wear loose clothing, tie back long hair; do not wear dangling jewellery.		
K-9.	K-9. Identify different bending and forming tools.	K-9. Associate the appropriate bending and forming tools to a specific task.	K-9. Describe preventive measures to be taken when using bending and forming tools.
	Bending and forming tools: e.g. sheet bender/former, pipe bender, vacuum former, hot air blower, strip wire heater, hammers/mallets.		
	Preventive measures: e.g. wear appropriate PPE, use suitable tools for the proper job, adopt good working posture, taking frequent breaks, remove sharp edges, avoid repetitive work movements.		
C-4.	C-4. Describe different methods of joining materials together.	C-4. Select a suitable joining method for different scenarios.	C-4. Justify a suitable joining method for different scenarios.
	Different methods of joining materials: e.g. <ul style="list-style-type: none"> • Wood: wood adhesives; wood joints; nails; screws, • Metal: welding; bolts and nuts; rivets; self-tapping screws, • Plastic: welding; adhesive; bolts and nuts; self-tapping screws. 		
A-2.	A-2. Prepare the necessary PPE, tools and materials to manufacture the required product.	A-2. Use the appropriate tools and materials to manufacture the required product.	A-2. Finish the required manufactured product to the given specifications.
	Preparation: PPE; tools; materials.		
	Using fabrication tools: handling of tools; good housekeeping; teamwork.		
	Product finishing to specifications: accuracy and precision (tolerance of 0.5mm); quality of workmanship.		

Subject Focus	Assembly and finishing tools and equipment		
LO 5.	Finish a given product to given specifications.		
K-10.	K-10. Identify assembly and finishing tools.	K-10. Relate assembly and finishing tools to specific tasks.	K-10. Describe preventive measures when using assembly and finishing tools and equipment.
	Assembly and finishing tools: <ul style="list-style-type: none"> • Assembly tools: spanners; sockets; screw drivers; universal bits; riveter; • Finishing tools: spray gun; sander; buffer; file; paint brush. 		
	Preventive measures: e.g. wear appropriate PPE, use suitable tool for the proper job, visual inspection of the tool, work to laid down procedures, do not wear loose clothing, tie back long hair; do not wear dangling jewellery.		
C-5.	C-5. Outline the importance of quality assurance when manufacturing a product.	C-5. Describe the necessary quality assurance checks to construct a given product according to specifications.	C-5. Evaluate which of the given products would meet given requirements following quality assurance checks.
	Importance of quality assurance: reduce waste; reduce time; reduce customer's complaints; increase quality of product; increase in profit.		
	Quality assurance checks: dimensions; quality of finish (edges, surface); functionality; final finishing. <i>N.B. For assessment purpose, TWO products with given specifications should be provided to candidates for evaluation against the quality assurance checks. Wherever specifications cannot be shown pictorially, a note should be added.</i>		
A-3.	A-3. Prepare the necessary PPE, tools and consumables to assemble and finish the required product.	A-3. Use the appropriate tools and material to assemble the required product.	A-3. Finish the required assembled and finished product to the given specifications.
	Preparation: PPE; tools; consumables.		
	Assembly of the required product: use necessary PPE appropriately; use necessary tools appropriately; assemble correctly to produce the required product. Finishing of the required product: dimensions; quality of finish (edges, surface); functionality; final finishing.		

***N.B.** No marks should be awarded in any application criteria unless candidates are wearing appropriate PPE throughout practical work.*

Learning Outcomes and Assessment Criteria

Subject Focus:	Health and Safety
Learning Outcome 1:	Prepare the necessary PPE according to statutory regulations.

Knowledge Criteria			Comprehension Criteria			Application Criteria		
Assessment Criteria (Level 1)	Assessment Criteria (Level 2)	Assessment Criteria (Level 3)	Assessment Criteria (Level 1)	Assessment Criteria (Level 2)	Assessment Criteria (Level 3)	Assessment Criteria (Level 1)	Assessment Criteria (Level 2)	Assessment Criteria (Level 3)
K-1. Identify personal protective equipment.	K-1. List personal protective equipment related to a given task/s.	K-1. Describe the functions of PPEs related to a given task/s.	C-1. Explain the consequences of not using the appropriate design and material of PPE for a specific activity.	C-1. Explain why given PPEs can have a different functional design or material.	C-1. Explain the choice of PPE with specific design and material for a given scenario.			
K-2. Match safety sign colours with their purpose.	K-2. Name the given safety signs.	K-2. Identify suitable safety signs for a given scenario.						
K-3. Match the responsibilities of the employer and the employees established by the Occupational Health and Safety Authority Act.	K-3. Assign given Health and Safety legislation to given scenarios.	K-3. Describe responsibilities in relation to Health and Safety legislation for a given incident.						

Subject Focus:	Materials
Learning Outcome 2:	Demonstrate an understanding of the properties of different types of materials and manufacturing processes.

<i>Knowledge Criteria</i>			<i>Comprehension Criteria</i>			<i>Application Criteria</i>		
Assessment Criteria (Level 1)	Assessment Criteria (Level 2)	Assessment Criteria (Level 3)	Assessment Criteria (Level 1)	Assessment Criteria (Level 2)	Assessment Criteria (Level 3)	Assessment Criteria (Level 1)	Assessment Criteria (Level 2)	Assessment Criteria (Level 3)
K-4. Identify the different forms of supply of metal.	K-4. List different properties of metals.	K-4. Explain why a particular form of supply and type of metal should be used for a given scenario.	C-2. Outline the different tests that can be carried out on materials.	C-2. Describe the test used to examine a particular material property.	C-2. Explain which test is required to determine the suitability of a given material for a given scenario.			
K-5. Identify the different forms of supply of wood.	K-5. List different properties of wood.	K-5. Explain why a particular form of supply and type of wood should be used for a given scenario.		C-3. Describe the result obtained after applying manufacturing processes on particular materials.	C-3. Justify suitable manufacturing processes for a given scenario/s.			
K-6. Identify the different forms of supply of polymers.	K-6. List different properties of polymers.	K-6. Explain why a particular form of supply and type of polymer should be used for a given scenario.	C-3. Outline manufacturing processes of particular materials.					

Subject Focus:	Measuring and marking out tools
Learning Outcome 3:	Make use of measuring and marking out tools.

Knowledge Criteria			Comprehension Criteria			Application Criteria		
Assessment Criteria (Level 1)	Assessment Criteria (Level 2)	Assessment Criteria (Level 3)	Assessment Criteria (Level 1)	Assessment Criteria (Level 2)	Assessment Criteria (Level 3)	Assessment Criteria (Level 1)	Assessment Criteria (Level 2)	Assessment Criteria (Level 3)
K-7. Identify different measuring and marking out tools.	K-7. Outline the functions of different measuring and marking out tools.	K-7. Choose the appropriate measuring and marking out tools for a specific task/s.				A-1. Prepare the necessary PPE, measuring and marking out tools and materials from a given engineering drawing.	A-1. Use measuring and marking out tools in the appropriate manner.	A-1. Carry out the necessary measurements and markings to a given tolerance.

Subject Focus:	Cutting, drilling, bending, forming and joining processes
Learning Outcome 4:	Make use of different tools safely and appropriately to produce an engineering component.

Knowledge Criteria			Comprehension Criteria			Application Criteria		
Assessment Criteria (Level 1)	Assessment Criteria (Level 2)	Assessment Criteria (Level 3)	Assessment Criteria (Level 1)	Assessment Criteria (Level 2)	Assessment Criteria (Level 3)	Assessment Criteria (Level 1)	Assessment Criteria (Level 2)	Assessment Criteria (Level 3)
K-8. Name different cutting and drilling tools.	K-8. Relate the appropriate cutting and drilling tools to a specific task.	K-8. Describe preventive measures to be taken when using cutting and drilling tools.	C-4. Describe different methods of joining materials together.	C-4. Select a suitable joining method for different scenarios.	C-4. Justify a suitable joining method for different scenarios.	A-2. Prepare the necessary PPE, tools and materials to manufacture the required product.	A-2. Use the appropriate tools and materials to manufacture the required product.	A-2. Finish the required manufactured product to the given specifications.
K-9. Identify different bending and forming tools.	K-9. Associate the appropriate bending and forming tools to a specific task.	K-9. Describe preventive measures to be taken when using bending and forming tools.						

Subject Focus:	Assembly and finishing tools and equipment
Learning Outcome 5:	Finish a given product to given specifications.

Knowledge Criteria			Comprehension Criteria			Application Criteria		
Assessment Criteria (Level 1)	Assessment Criteria (Level 2)	Assessment Criteria (Level 3)	Assessment Criteria (Level 1)	Assessment Criteria (Level 2)	Assessment Criteria (Level 3)	Assessment Criteria (Level 1)	Assessment Criteria (Level 2)	Assessment Criteria (Level 3)
K-10. Identify assembly and finishing tools.	K-10. Relate assembly and finishing tools to specific tasks.	K-10. Describe preventive measures when using assembly and finishing tools and equipment.	C-5. Outline the importance of quality assurance when manufacturing a product.	C-5. Describe the necessary quality assurance checks to construct a given product according to specifications.	C-5. Evaluate which of the given products would meet given requirements following quality assurance checks.	A-3. Prepare the necessary PPE, tools and consumables to assemble and finish the required product.	A-3. Use the appropriate tools and material to assemble the required product.	A-3. Finish the required assembled and finished product to the given specifications.

Unit 2: Electronic Circuits Designs

Unit Description

This unit equips the candidate with a skill set of theoretical and practical knowledge relating to the domains of electrical and electronic circuits.

Through the successful completion of this unit, the candidate 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 candidate will also be in a position to assemble and test simple circuits on prototype boards such as a breadboard and a stripboard, and also manufacture a printed circuit board.

Learning Outcomes

At the end of the unit, I can:

- LO 6.** Demonstrate an understanding of voltage, current and resistance.
- LO 7.** Recognize basic circuit structures.
- LO 8.** Demonstrate knowledge of capacitors and resistors in timing circuits.
- LO 9.** Use semi-conductors and integrated circuits.
- LO 10.** Construct and test digital and analogue circuits safely and effectively.

Assessment Criteria and Content

Subject Focus	Voltage, current and resistance		
LO 6.	Demonstrate an understanding of voltage, current and resistance.		
K-11.	K-11. Categorise different materials as insulators, conductors.	K-11. Define the term semi-conductor.	K-11. State the relationship between parameters affecting the resistance of a material.
	Materials: <ul style="list-style-type: none"> Conductors: e.g. gold, silver, copper, aluminium, iron, steel, brass, bronze, mercury; Insulators: e.g. glass, rubber, oil, paper, fiberglass, porcelain, ceramic, plastic, wood. 		
	Parameters affecting the resistance of material ($R = \rho l/A$): resistivity of material; length; cross-sectional area of material.		
K-12.	K-12. Identify different types of resistors.	K-12. Outline different types of DC voltage sources.	K-12. Indicate how to use a multi-meter to measure current and voltage across a resistor.
	Resistors: fixed resistor; potentiometer; pre-set resistor; LDR; thermistor.		
	DC voltage sources: e.g. batteries, power supplies, solar cells.		
C-6.	Use of multi-meter: in series to measure current; in parallel to measure voltage.		
	C-6. Describe the relationship between resistance, voltage and current giving the SI unit for each parameter.	C-6. Determine the resistance from a given VI graph of an ohmic component.	C-6. Calculate a missing value using Ohm's law.
	Relationship between resistance, voltage and current: description; equation (Ohm's Law); correct SI units.		
	Resistance from a given VI graph: correct working including gradient; correct final answer value; correct SI unit in final answer.		
C-6.	Missing values: correct subject of the formula; correct final answer value; correct SI unit in final answer.		
	N.B. For assessment purposes, multiple circuits may be provided to calculate different values.		

Subject Focus	Basic circuit structures		
LO 7.	Recognize basic circuit structures.		
K-13.	K-13. Differentiate between open and closed circuit.	K-13. Draw a series and/or a parallel circuit.	K-13. Identify a parallel and a series sub-circuit in a given circuit.
	<p>Series and parallel circuit components: switches; batteries; bulbs; resistors.</p> <p>N.B. For assessment purposes at Level 2, the circuit should be limited to ONE battery and TWO other components only.</p>		
K-14.	K-14. Identify different designs of switches.	K-14. Identify different types of switches in terms of poles and throws.	K-14. Select the appropriate switch for given scenarios.
	Different designs of switches e.g. toggle, slide, rocker, reed, tilt, push, rotary, key.		
	<p>Different types of switches in terms of poles and throws: SPST; SPDT; DPDT; push to make; push to break.</p> <p>N.B. For assessment purposes at Level 3, each scenario should require a different type of switch.</p>		
C-7.	C-7. Find the total resistance in a series circuit.	C-7. Find the total resistance in a parallel circuit.	C-7. Find the total resistance of a circuit containing series and parallel sub-circuits.
	<p>Calculating total resistance: working; correct answer.</p> <p>N.B. For assessment purposes at Level 3, multiple circuits may be provided.</p>		

Subject Focus	Capacitors and resistors		
LO 8.	Demonstrate knowledge of capacitors and resistors in timing circuits.		
K-15.	K-15. Identify different types of capacitors.	K-15. Sketch the voltage-time graph of charging and discharging.	K-15. Rank different capacitance values in order.
	Different types of capacitors: electrolytic; ceramic; film; power film.		
	Sketching of voltage-time graph: charging; discharging		
	N.B. For assessment purposes, the values given should include any of the following prefixes: Farad; Millifarad; Microfarad; Nanofarad; Picofarad.		
C-8.	C-8. Find the total capacitance in a parallel circuit.	C-8. Find the total capacitance in a series circuit.	C-8. Find the value of a missing parameter in an RC circuit.
	Determining total capacitance for capacitors: working; correct answer.		
	Determining missing values in RC circuits ($T=RC$): working; correct answer.		
A-4.	A-4. Construct a given RC circuit on a stripboard using a variable resistor and a fixed capacitor.	A-4. Connect the oscilloscope to the circuit to display the charging of the capacitor.	A-4. Calibrate the circuit to satisfy a given time constant.
	Construction of RC circuits: correct configuration of circuit; correct selection of components; correct use of stripboard.		
	Use of oscilloscope to display output of RC circuit: correct connection of probes; correct use of oscilloscope; correct readings of oscilloscope.		
	Calibration of circuit to satisfy a given time constant: correct calibration; recording of resistance; recording of capacitance; confirming results with $T=RC$.		

Subject Focus	Semi-conductor devices and integrated circuits		
LO 9.	Use semi-conductors and integrated circuits.		
K-16.	K-16. Identify different types of signals.	K-16. Define parameters of a given signal and their SI units.	K-16. Label important features of an oscilloscope.
	Different types of signals: sine; square; triangle; DC; saw tooth.		
	Parameters of signal: amplitude; frequency; periodic time; corresponding SI units.		
	Features of an oscilloscope: display; probes; vertical controls; horizontal controls.		

K-17.	K-17. List different types of analogue devices.	K-17. List the characteristics of diodes and transistors.	K-17. Describe the function of diodes and transistors.
	Analogue devices: diodes; transistors.		
	Physical characteristics of diodes and transistors devices: <ul style="list-style-type: none"> • Diode: semiconductor material; cathode; anode; forward biased; reverse biased; • Transistor: semiconductor material; emitter; collector; base; NPN/PNP. 		
K-18.	K-18. Identify the pinouts of an integrated circuit (IC) from a data sheet.	K-18. List different IC package types.	K-18. Describe the advantages of using ICs in circuits.
	Pin-outs of ICs: numbering of pinouts; identification of Gnd and Vcc.		
	IC package types: surface mount; through hole; single in-line; dual in-line.		
	Advantages of ICs: size; weight; efficiency; cost; reliability.		
C-9.	C-9. List different types of logic gates and their respective symbols.	C-9. Write the truth table of different logic gates.	C-9. Determine the output of a multi staged circuit using logic gates.
	Logic Gates: e.g. AND, OR, NOT, NAND, NOR, XOR, XNOR.		
	Truth Tables of Logic Gates: e.g. AND, OR, NOT, NAND, NOR, XOR, XNOR.		
	N.B. For assessment purposes, a multi staged circuit using a configuration of any THREE of the following logic gates – with inputs provided in the question – should be considered: AND and/or OR and/or NOT.		
A-5.	A-5. Prepare the required components and equipment to assemble a given circuit.	A-5. Use a breadboard to assemble a given circuit.	A-5. Use testing equipment to confirm the expected output of the circuit.
	Preparation of circuit construction: acquiring the correct components from the schematic diagram; preparing required equipment.		
	Construction of circuit on breadboard: correct assembly of components on breadboard; minimal use of jumpers; teamwork; good housekeeping.		
	N.B. It is highly suggested that the typical circuits be considered: 555-timer ICs, counter circuits, sensing circuits, sound to light circuits.		
	Testing of circuit: using multi-meter to test circuits; using oscilloscope to test circuits.		

Subject Focus	Construction and testing of circuits		
LO 10.	Construct and test digital and analogue circuits safely and effectively.		
K-19.	K-19. Identify electronic symbols.	K-19. Match SI units to their respective parameters.	K-19. Identify different packaging of the same electronic components.
	Identifying electronic symbols: e.g. resistor, LDR, capacitor, diode, operational amplifier, transistor, motor, battery, SPST switch.		
	SI units: Amps; Ohms; Volts; Watts; Farads.		
	Packaging of the same electronic components: radial vs. axial; through hole vs. surface mount; dual in-line vs. single in-line; different pin-out spacing.		
K-20.	K-20. Label different tools used in electronic circuit construction.	K-20. Identify correct steps to use a soldering iron effectively	K-20. Outline the functions of different tools for circuit construction.
	Tools required to construct electronic circuits: e.g. soldering iron, wire stripper, side cutter, long nose pliers, third hand, de-soldering pump, solder wick, track cutter, PCB driller.		
	Soldering iron process: clean soldering iron tip; free board from oxidization; apply the required heat to component pin and copper track; apply the correct amount of solder; allow the solder joint to solidify appropriately.		
C-10.	C-10. Identify suitable warning signs for given hazardous scenarios.	C-10. State hazards that might be present when manufacturing a PCB.	C-10. Identify ways to eliminate or minimize the risks involved when manufacturing a PCB.
	Warning signs for hazardous substances: e.g. gas under pressure, explosives, oxidizing, flammable, corrosive, health hazard, acute toxicity, serious health hazards; hazardous to the environment.		
	Hazards when manufacturing a PCB:		
	<ul style="list-style-type: none"> Etching of PCB: chemical spill; inhaling dangerous fumes; Drilling of PCB: airborne fragments; cuts; Soldering: burns; dangerous fumes from solder. 		
A-6.	A-6. Design the artwork of the PCB using electronics software.	A-6. Manufacture a printed circuit board using the chemical process.	A-6. Test the functionality of the PCB.
	Design: efficient use of PCB space; efficient use of jumpers; thickness of tracks.		
	Manufacture: preparation of PPE; correct use of equipment; good housekeeping; teamwork.		
	Test: correct use of testing equipment; functionality of circuit.		

N.B. No marks should be awarded in any application criteria unless candidates are wearing appropriate PPE throughout practical work.

Learning Outcomes and Assessment Criteria

Subject Focus:	Voltage, current and resistance
Learning Outcome 6:	Demonstrate an understanding of voltage, current and resistance.

Knowledge Criteria			Comprehension Criteria			Application Criteria		
Assessment Criteria (Level 1)	Assessment Criteria (Level 2)	Assessment Criteria (Level 3)	Assessment Criteria (Level 1)	Assessment Criteria (Level 2)	Assessment Criteria (Level 3)	Assessment Criteria (Level 1)	Assessment Criteria (Level 2)	Assessment Criteria (Level 3)
K-11. Categorise different materials as insulators, conductors.	K-11. Define the term semi-conductor.	K-11. State the relationship between parameters affecting the resistance of a material.	C-6. Describe the relationship between resistance, voltage and current giving the SI unit for each parameter.	C-6. Determine the resistance from a given VI graph of an ohmic component.	C-6. Calculate a missing value using Ohm's law.			
K-12. Identify different types of resistors.	K-12. Outline different types of DC voltage sources.	K-12. Indicate how to use a multi-meter to measure current and voltage across a resistor.						

Subject Focus:	Basic circuit structures
Learning Outcome 7:	Recognize basic circuit structures.

Knowledge Criteria			Comprehension Criteria			Application Criteria		
Assessment Criteria (Level 1)	Assessment Criteria (Level 2)	Assessment Criteria (Level 3)	Assessment Criteria (Level 1)	Assessment Criteria (Level 2)	Assessment Criteria (Level 3)	Assessment Criteria (Level 1)	Assessment Criteria (Level 2)	Assessment Criteria (Level 3)
K-13. Differentiate between open and closed circuit.	K-13. Draw a series and/or a parallel circuit.	K-13. Identify a parallel and a series sub-circuit in a given circuit.	C-7. Find the total resistance in a series circuit.	C-7. Find the total resistance in a parallel circuit.	C-7. Find the total resistance of a circuit containing series and parallel sub-circuits.			
K-14. Identify different designs of switches.	K-14. Identify different types of switches in terms of poles and throws.	K-14. Select the appropriate switch for given scenarios.						

Subject Focus:	Capacitors and Resistors
Learning Outcome 8:	Demonstrate knowledge of capacitors and resistors in timing circuits.

Knowledge Criteria			Comprehension Criteria			Application Criteria		
Assessment Criteria (Level 1)	Assessment Criteria (Level 2)	Assessment Criteria (Level 3)	Assessment Criteria (Level 1)	Assessment Criteria (Level 2)	Assessment Criteria (Level 3)	Assessment Criteria (Level 1)	Assessment Criteria (Level 2)	Assessment Criteria (Level 3)
K-15. Identify different types of capacitors.	K-15. Sketch the voltage-time graph of charging and discharging.	K-15. Rank different capacitance values in order.	C-8. Find the total capacitance in a parallel circuit.	C-8. Find the total capacitance in a series circuit.	C-8. Find the value of a missing parameter in an RC circuit.	A-4. Construct a given RC circuit on a stripboard using a variable resistor and a fixed capacitor.	A-4. Connect the oscilloscope to the circuit to display the charging of the capacitor.	A-4. Calibrate the circuit to satisfy a given time constant.

Subject Focus:	Semi-conductor devices and integrated circuits
Learning Outcome 9:	Use semi-conductors and integrated circuits.

Knowledge Criteria			Comprehension Criteria			Application Criteria		
Assessment Criteria (Level 1)	Assessment Criteria (Level 2)	Assessment Criteria (Level 3)	Assessment Criteria (Level 1)	Assessment Criteria (Level 2)	Assessment Criteria (Level 3)	Assessment Criteria (Level 1)	Assessment Criteria (Level 2)	Assessment Criteria (Level 3)
K-16. Identify different types of signals.	K-16. Define parameters of a given signal and their SI units.	K-16. Label important features of an oscilloscope.						
K-17. List different types of analogue devices.	K-17. List the characteristics of diodes and transistors.	K-17. Describe the function of diodes and transistors.	C-9. List different types of logic gates and their respective symbols.	C-9. Write the truth table of different logic gates.	C-9. Determine the output of a multi staged circuit using logic gates.	A-5. Prepare the required components and equipment to assemble a given circuit.	A-5. Use a breadboard to assemble a given circuit.	A-5. Use testing equipment to confirm the expected output of the circuit.
K-18. Identify the pinouts of an integrated circuit (IC) from a data sheet.	K-18. List different IC package types.	K-18. Describe the advantages of using ICs in circuits.						

Subject Focus:	Construction and testing of circuits
Learning Outcome 10:	Construct and test digital and analogue circuits safely and effectively.

Knowledge Criteria			Comprehension Criteria			Application Criteria		
Assessment Criteria (Level 1)	Assessment Criteria (Level 2)	Assessment Criteria (Level 3)	Assessment Criteria (Level 1)	Assessment Criteria (Level 2)	Assessment Criteria (Level 3)	Assessment Criteria (Level 1)	Assessment Criteria (Level 2)	Assessment Criteria (Level 3)
K-19. Identify electronic symbols.	K-19. Match SI units to their respective parameters.	K-19. Identify different packaging of the same electronic components.	C-10. Identify suitable warning signs for given hazardous scenarios.	C-10. State hazards that might be present when manufacturing a PCB.	C-10. Identify ways to eliminate or minimize the risks involved when manufacturing a PCB.	A-6. Design the artwork of the PCB using electronics software.	A-6. Manufacture a printed circuit board using the chemical process.	A-6. Test the functionality of the PCB.
K-20. Label different tools used in electronic circuit construction.	K-20. Identify correct steps to use a soldering iron effectively	K-20. Outline the functions of different tools for circuit construction.						

Unit 3: Electro-mechanical Systems

Unit Description

This unit equips the candidate with a skill set of theoretical and practical knowledge related to the domains of AC current, coils, and different mechanical systems. This basic knowledge is imperative in understanding the inner workings of different power tools. Candidates can then go into the use, maintenance and care of different power tools.

Through this unit, learners will be able to read and interpret technical information to construct an electro-mechanical product using multiple power tools, safely and efficiently.

Learning Outcomes

At the end of the unit, I can:

- LO 11.** Demonstrate knowledge of alternating current and coils.
- LO 12.** Demonstrate an understanding of power tools and their individual mechanical components.
- LO 13.** Demonstrate knowledge of emergency procedures.
- LO 14.** Construct an electro-mechanical product using power tools from given documentation.

Assessment Criteria and Content

Subject Focus	Alternating current and coils		
LO 11.	Demonstrate knowledge of alternating current and coils.		
K-21.	K-21. Name the different types of electrical power generation plants.	K-21. Differentiate between consumers and prosumers in electrical power generation.	K-21. Outline how electrical power reaches the consumer from a power generation plant.
	Different types of electrical power generation plants: e.g. fossil-fuel, nuclear, geothermal, hydroelectric, wind, solar.		
	Electricity generation, transmission and distribution: power plant; step-up transformer; transmission lines; step-down transformer; consumer unit.		
K-22.	K-22. List applications of electromagnetic devices.	K-22. Outline the working principle of an electromagnet.	K-22. Describe how a relay achieves its function through its individual parts.
	Different applications of electromagnetic devices: e.g. relays, loudspeakers, microphones, transformers, motors and generators, solenoid.		
	Working principle of an electromagnet: relationship between electricity and magnetism.		
K-23.	K-23. List different types of motors.	K-23. Match the different types of motors with their specific use.	K-23. Describe the working principles of a DC motor.
	Different types of motors: DC motors; brushless motors; stepper motors; servo motors.		
	Working principles of a DC Motor: magnetism; current.		
C-11.	C-11. Outline the importance of selecting a fuse with the appropriate current rating.	C-11. Calculate the appropriate rating of a fuse.	C-11. Discuss the main differences between an MCB and a fuse.
	Selecting the correct rating of a fuse: function; hazards that might arise when selecting inappropriate fuse.		
	Calculate the appropriate rating of a BS1361 fuse (or equivalent): $\text{Power} = \text{Voltage} \times \text{Current}$.		
	Difference between an MCB and a fuse: cost; sensitivity to current overload; sacrificial vs. reset; ease to resume supply.		

C-12.	C-12. Identify whether a step-up or a step-down transformer is required for a given scenario.	C-12. Explain the working principle of a step-up and a step-down transformer.	C-12. Determine the missing value using the transformer-ratio formula.
	Transformer-ratio formula: $\frac{N_1}{N_2} = \frac{V_1}{V_2}$ N.B. For assessment purposes at Level 3, current should not be considered.		
A-7.	A-7. Design a circuit to control the direction of a DC motor.	A-7. Construct a circuit to control the direction of a DC motor.	A-7. Construct a circuit to control the speed of a DC motor.
	Design: neatness; selection of the proper components; correct wiring.		
	Construction of a circuit on stripboard to control the direction of a DC motor: <ul style="list-style-type: none"> • Proper connection of components: wiring; soldering; • Functionality. 		
	Construction of a circuit on stripboard to control the speed of a DC motor: <ul style="list-style-type: none"> • Proper connection of components: wiring; soldering; • Functionality. 		
A-8.	A-8. Prepare the necessary tools to wire a three-pin plug.	A-8. Carry out the task of wiring a three-pin plug to a cord using the correct procedure.	A-8. Carry out the installation of the wired plug to a trailing socket.
	Preparation: tools; components.		
	Wiring a three-pin plug: correct stripping technique; correct identification of wires, correct length of insulation and outer jacket; correct assembling of cable grip.		
	Wiring to trailing socket: Correct stripping technique; correct identification of wires; correct length of insulation and outer jacket; correct assembling of trailing socket.		

Subject Focus	Power tools		
LO 12.	Demonstrate an understanding of power tools and their individual mechanical components.		
K-24.	K-24. List different types of bearings.	K-24. Identify different factors that causes premature bearing failure.	K-24. Outline how different bearings can be replaced.
	Different types of bearings: e.g. ball bearing, roller bearing, tapered roller bearing, thrust bearing, magnetic bearing, fluid bearing.		
	Accelerated bearing failure factors: heavier load than designed for; inadequate lubrication; ineffective bearing sealing; shaft misalignment; incorrect fit.		
	Replacing bearings: using a bearing puller; using a press; heating inside diameter of bearing; using wax or grease to force out a thrust bearing.		

K-25.	K-25. Identify different mechanical systems.	K-25. Describe the function of mechanical systems.	K-25. List the advantages and disadvantages of gears and pulleys.
	Different mechanical systems: e.g. gears, pulleys, chain and sprocket, levers and linkages, crank and slider, cam and follower.		
	Functions of mechanical systems: e.g. change in rotational direction, change in rotational speeds, conversion of rotational to linear motion, conversion of linear motion to rotational motion, mechanical advantages, linking two or more shafts.		
	<p>Advantages and disadvantages of gear and pulley systems:</p> <ul style="list-style-type: none"> • Advantages of a gear drive system: e.g. it is more efficient than a pulley drive because it does not slip, multiple output rotational speeds can be obtained by using a suitable gear drive, compared to other drives it has a longer life; • Disadvantages of a gear drive system: e.g. it needs lubrication, more expensive to produce than a pulley drive system, it produces more noise than a pulley system; • Advantages of a pulley drive system: e.g. no lubricant is required, noise is relatively less, if the belt breaks during overload it will protect the machine from damage; • Disadvantages of a pulley drive system: e.g. power loss due to the belt slipping over the pulley, the belt needs to be adjusted to the correct tension from time to time, life of the belt is relatively low. 		
C-13.	C-13. Describe preventative measures before using power tools.	C-13. Describe safety measures while using power tools.	C-13. Explain maintenance and care practices of power tools and machinery.
	Preventative measures before using power tools: e.g. ensure that you have been properly trained to use the tool, inspect tools for any damage, inspect plug and cord for defects, ensure that the tool is properly grounded using a three-pin plug, ensure that the power tool has the correct guard, check for damaged switches or faulty trigger locks.		
	Safety measures while using a power tool: e.g. wear or use personal protective equipment (PPE), keep power cords clear of tools and the path that the cutting tool will take, make use of clamps or vices to hold and support the workpiece, disconnect the power supply before making adjustments or changing accessories, follow good housekeeping procedures, ensure that cutting tools and drills are kept sharp.		
	<p>Maintenance and care practices of power tools and machinery: e.g. store power tools in a dry and secure location when not in use, cool down heated power tools, ensure proper cleaning of equipment from dust or particulate matter, lubricate moving parts with oil or grease, use a power tool only for its designated load and material, pull the plug not the cord when unplugging a power tool, replace worn parts.</p> <p>N.B. It is suggested that reference is made to the following power tools and machinery: e.g. power drill/pillar drill, jigsaw, circular saw, grinder, lathe, belt sander, milling machine.</p>		

Subject Focus	Health and Safety		
LO 13.	Demonstrate knowledge of emergency procedures.		
K-26.	K-26. Match the main classes of fire with their type.	K-26. Identify the proper fire extinguisher for different classes of fire.	K-26. Describe important practices to adopt when a fire emergency occurs.
	<p>Main classes of fire and their types:</p> <ul style="list-style-type: none"> • Class A - Fires with trash, wood, paper or other combustible materials as the fuel source; • Class B - Fires with flammable or combustible liquids as the fuel source; • Class C - Fires involving gases; • Class D - Fires involving combustible metals; • Class E - Fires involving electrical equipment; • Class F - Fires involving cooking oils. 		
	Fire extinguishers for the different classes of fire: e.g. water, foam, powder, CO2, dry and wet chemical extinguisher, fire blanket.		
	Important practices to adopt when a fire emergency occurs: sound the fire alarm; if you are trained and the fire is still contained try to put it out using the correct fire extinguisher; do not take out with you any personal belongings; evacuate the building via the escape route to the assembly area avoiding lifts.		
C-14.	C-14. State the required information needed when reporting an emergency situation.	C-14. Describe the necessary procedure to perform when particular incidents occur in a workshop.	C-14. Identify Health and Safety risks in a given scenario justifying whether they are low, medium or high.
	Required information needed when reporting an emergency: location; number of casualties; type of injuries; age of casualty; contact number.		
	Incidents that may occur in a workshop: e.g. electric shock, cuts, burns, falling from height, penetration of foreign body, fractures.		

Subject Focus	Electro-mechanical product		
LO 14.	Construct an electro-mechanical product using power tools from given documentation.		
K-27.	K-27. List different types of documentation.	K-27. Identify different types of documentation.	K-27. Describe the function of different types of documentation.
	Different types of documentation: e.g. job card, fabrication drawing, data sheet, assembly drawing, repair and maintenance diagram, risk assessment.		
A-9.	A-9. Carry out a Health and Safety risk assessment to construct a product which includes a mechanical and an electronic aspect.	A-9. Prepare documentation, materials, tools and PPE needed to construct an electro-mechanical product.	A-9. Construct an electro-mechanical product with the use of multiple power tools.
	Risk assessment: identification of hazards; likelihood of the risk involved (High, Medium, Low); measures to eliminate or lower the risks involved.		
	Preparation: documentation; tools and materials; PPE.		
	Construct an electro-mechanical product: use power tools correctly; accuracy and precision; function; quality.		

N.B. No marks should be awarded in any application criteria unless candidates are wearing appropriate PPE throughout practical work.

Learning Outcomes and Assessment Criteria

Subject Focus:	Alternating current and coils
Learning Outcome 11:	Demonstrate knowledge of alternating current and coils.

Knowledge Criteria			Comprehension Criteria			Application Criteria		
Assessment Criteria (Level 1)	Assessment Criteria (Level 2)	Assessment Criteria (Level 3)	Assessment Criteria (Level 1)	Assessment Criteria (Level 2)	Assessment Criteria (Level 3)	Assessment Criteria (Level 1)	Assessment Criteria (Level 2)	Assessment Criteria (Level 3)
K-21. Name the different types of electrical power generation plants.	K-21. Differentiate between consumers and prosumers in electrical power generation.	K-21. Outline how electrical power reaches the consumer from a power generation plant.	C-11. Outline the importance of selecting a fuse with the appropriate current rating.	C-11. Calculate the appropriate rating of a fuse.	C-11. Discuss the main differences between an MCB and a fuse.	A-7. Design a circuit to control the direction of a DC motor.	A-7. Construct a circuit to control the direction of a DC motor.	A-7. Construct a circuit to control the speed of a DC motor.
K-22. List applications of electromagnetic devices.	K-22. Outline the working principle of an electromagnet.	K-22. Describe how a relay achieves its function through its individual parts.						
K-23. List different types of motors.	K-23. Match the different types of motors with their specific use.	K-23. Describe the working principles of a DC motor.	C-12. Identify whether a step-up or a step-down transformer is required for a given scenario.	C-12. Explain the working principle of a step-up and a step-down transformer.	C-12. Determine the missing value using the transformer-ratio formula.	A-8. Prepare the necessary tools to wire a three-pin plug.	A-8. Carry out the task of wiring a three-pin plug to a cord using the correct procedure.	A-8. Carry out the installation of the wired plug to a trailing socket.

Subject Focus:	Power tools
Learning Outcome 12:	Demonstrate an understanding of power tools and their individual mechanical components.

Knowledge Criteria			Comprehension Criteria			Application Criteria		
Assessment Criteria (Level 1)	Assessment Criteria (Level 2)	Assessment Criteria (Level 3)	Assessment Criteria (Level 1)	Assessment Criteria (Level 2)	Assessment Criteria (Level 3)	Assessment Criteria (Level 1)	Assessment Criteria (Level 2)	Assessment Criteria (Level 3)
K-24. List different types of bearings.	K-24. Identify different factors that causes premature bearing failure.	K-24. Outline how different bearings can be replaced.	C-13. Describe preventative measures before using power tools.	C-13. Describe safety measures while using power tools.	C-13. Explain maintenance and care practices of power tools and machinery.			
K-25. Identify different mechanical systems.	K-25. Describe the function of mechanical systems.	K-25. List the advantages and disadvantages of gears and pulleys.						

Subject Focus:	Health and Safety
Learning Outcome 13:	Demonstrate knowledge of emergency procedures.

Knowledge Criteria			Comprehension Criteria			Application Criteria		
Assessment Criteria (Level 1)	Assessment Criteria (Level 2)	Assessment Criteria (Level 3)	Assessment Criteria (Level 1)	Assessment Criteria (Level 2)	Assessment Criteria (Level 3)	Assessment Criteria (Level 1)	Assessment Criteria (Level 2)	Assessment Criteria (Level 3)
K-26. Match the main classes of fire with their type.	K-26. Identify the proper fire extinguisher for different classes of fire.	K-26. Describe important practices to adopt when a fire emergency occurs.	C-14. State the required information needed when reporting an emergency situation.	C-14. Describe the necessary procedure to perform when particular incidents occur in a workshop.	C-14. Identify Health and Safety risks in a given scenario justifying whether they are low, medium or high.			

Subject Focus:	Electro-mechanical product
Learning Outcome 14:	Construct an electro-mechanical product using power tools from given documentation.

Knowledge Criteria			Comprehension Criteria			Application Criteria		
Assessment Criteria (Level 1)	Assessment Criteria (Level 2)	Assessment Criteria (Level 3)	Assessment Criteria (Level 1)	Assessment Criteria (Level 2)	Assessment Criteria (Level 3)	Assessment Criteria (Level 1)	Assessment Criteria (Level 2)	Assessment Criteria (Level 3)
K-27. List different types of documentation.	K-27. Identify different types of documentation.	K-27. Describe the function of different types of documentation.				A-9. Carry out a Health and Safety risk assessment to construct a product which includes a mechanical and an electronic aspect.	A-9. Prepare documentation, materials, tools and PPE needed to construct an electro-mechanical product.	A-9. Construct an electro-mechanical product with the use of multiple power tools.

Appendix 1 – Minimum Required Resources

This list is not intended to be exhaustive. It is highly recommended that tools listed hereunder should be educational. These resources should be available for at least 16 candidates.

Per workshop

- **Marking out tools:** chalk line; surface plate; blueing or paint; scribing block; mortise gauge;
- **Measuring tools:** micrometre; gauges;
- **Power tools and machinery:**
 - Machinery: lathe, sanding machines; band saw; pillar drill; strip wire heater; vacuum former; angle grinder; circular saw; scroll saw;
 - Electronics: UV box; etching tank;
- **Test Bench Equipment:** oscilloscope; signal generator.

Per candidate

- **Measuring tools:** ruler;
- **Hand tools (Electronics):** soldering iron; wire stripper; side cutter; long nose pliers; third hand.

Per group of 2 candidates

- **Benches:** woodworking benches; metal working benches.

Per group of 2-4 candidates

- **Marking out tools:** scribe; 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.

Appendix 2 – Portfolio Marking Schemes

PART 1 – BASED ON ANY TWO APPLICATION CRITERIA FROM UNIT 1				Criterion 1 Marks	Criterion 2 Marks	Total Marks
Overview of Application Process	1 – 3 marks	4 – 6 marks	7 – 10 marks			
	Steps required as part of the overall process to complete the whole criterion are provided – without any details or elaboration – but most are missing, incorrect, or not necessarily in logical order.	The main steps required as part of the overall process to complete the whole criterion are provided – including some detail or elaboration – but some are missing, incorrect, or not necessarily in logical order.	Most of, or all, the main steps required as part of the overall process to complete the whole criterion are correctly provided – including necessary details or elaboration – and in a logical order.	/10	/10	/20
Supporting Evidence	1 – 2 marks	3 – 4 marks	5 – 7 marks	/7	/7	/14
	The submitted photo evidence only shows the final work or artifact. Linking to supporting evidence does not exist or is inconsistent.	The submitted photo evidence shows some steps and the final work or artifact. Linking to supporting evidence is overall consistent.	The submitted photo evidence shows most of, or all, the main steps and the final work or artifact, using proper captions. Linking to supporting evidence is consistent throughout.			
Overview of Skills	1 – 3 marks	4 – 6 marks	7 – 10 marks	/10	/10	/20
	Underlying skills employed to complete the criterion are provided – without any details or elaboration – but most are missing or incorrect.	The main underlying skills employed to complete the criterion are provided – including some details or elaboration – but some are missing or incorrect.	Most of, or all, the main underlying skills employed to complete the criterion are correctly provided – including necessary details or elaboration.			
Presentation	1 mark	2 – 3 marks	4 – 6 marks			/6
	The material submitted for this part of the Portfolio generally follows the template, but the overall presentation is poor and/or inconsistent.	The material submitted for this part of the Portfolio follows the template, and the overall presentation is good and consistent.	The material submitted for this part of the Portfolio follows the template, and the presentation is excellent and consistent throughout. A proper Table of Contents is also included.			
TOTAL PART 1 MARK						/60

PART 2 – BASED ON ANY TWO APPLICATION CRITERIA FROM UNIT 2				Criterion 1 Marks	Criterion 2 Marks	Total Marks
Overview of Application Process	1 – 3 marks	4 – 6 marks	7 – 10 marks	/10	/10	/20
	Steps required as part of the overall process to complete the whole criterion are provided – without any details or elaboration – but most are missing, incorrect, or not necessarily in logical order.	The main steps required as part of the overall process to complete the whole criterion are provided – including some detail or elaboration – but some are missing, incorrect, or not necessarily in logical order.	Most of, or all, the main steps required as part of the overall process to complete the whole criterion are correctly provided – including necessary details or elaboration – and in a logical order.			
Supporting Evidence	1 – 2 marks	3 – 4 marks	5 – 7 marks	/7	/7	/14
	The submitted photo evidence only shows the final work or artifact. Linking to supporting evidence does not exist or is inconsistent.	The submitted photo evidence shows some steps and the final work or artifact. Linking to supporting evidence is overall consistent.	The submitted photo evidence shows most of, or all, the main steps and the final work or artifact, using proper captions. Linking to supporting evidence is consistent throughout.			
Overview of Skills	1 – 3 marks	4 – 6 marks	7 – 10 marks	/10	/10	/20
	Underlying skills employed to complete the criterion are provided – without any details or elaboration – but most are missing or incorrect.	The main underlying skills employed to complete the criterion are provided – including some details or elaboration – but some are missing or incorrect.	Most of, or all, the main underlying skills employed to complete the criterion are correctly provided – including necessary details or elaboration.			
Presentation	1 mark	2 – 3 marks	4 – 6 marks			/6
	The material submitted for this part of the Portfolio generally follows the template, but the overall presentation is poor and/or inconsistent.	The material submitted for this part of the Portfolio follows the template, and the overall presentation is good and consistent.	The material submitted for this part of the Portfolio follows the template, and the presentation is excellent and consistent throughout. A proper Table of Contents is also included.			
TOTAL PART 2 MARK						/60

PART 3 – BASED ON ONE UNIT 3 APPLICATION CRITERION AND SELF-EVALUATION					Total Marks
Overview of Application Process		1 – 3 marks Steps required as part of the overall process to complete the whole criterion are provided – without any details or elaboration – but most are missing, incorrect, or not necessarily in logical order.	4 – 6 marks The main steps required as part of the overall process to complete the whole criterion are provided – including some detail or elaboration – but some are missing, incorrect, or not necessarily in logical order.	7 – 10 marks Most of, or all, the main steps required as part of the overall process to complete the whole criterion are correctly provided – including necessary details or elaboration – and in a logical order.	/10
	Supporting Evidence		1 – 2 marks The submitted photo evidence only shows the final work or artifact. Linking to supporting evidence does not exist or is inconsistent.	3 – 4 marks The submitted photo evidence shows some steps and the final work or artifact. Linking to supporting evidence is overall consistent.	
Overview of Skills			1 – 3 marks Underlying skills employed to complete the criterion are provided – without any details or elaboration – but most are missing or incorrect.	4 – 6 marks The main underlying skills employed to complete the criterion are provided – including some details or elaboration – but some are missing or incorrect.	7 – 10 marks Most of, or all, the main underlying skills employed to complete the criterion are correctly provided – including necessary details or elaboration.
	Self-Evaluation		1 – 8 marks One soft and one technical skill gained throughout the subject are evaluated in relation to personal growth or future employment in industry. The arguments linking the skills gained with their contribution towards personal growth or future employment are generic or weak.	9 – 16 marks Various soft and technical skills gained throughout the subject are evaluated in relation to personal growth and future employment in industry. The arguments linking the skills gained with their contribution towards personal growth and future employment are valid, but some are not properly developed.	17 – 27 marks Various soft and technical skills gained throughout the subject are evaluated in relation to personal growth and future employment in industry. Most of, or all the arguments linking the skills gained with their contribution towards personal growth and future employment are properly developed.
Presentation			1 mark The material submitted for this part of the Portfolio generally follows the template, but the overall presentation is poor and/or inconsistent.	2 – 3 marks The material submitted for this part of the Portfolio follows the template, and the overall presentation is good and consistent.	4 – 6 marks The material submitted for this part of the Portfolio follows the template, and the presentation is excellent and consistent throughout. A proper Table of Contents is also included.
	TOTAL PART 3 MARK				