

TECHNICAL STUDIES AT HOËRSKOOL BERGVLAM

ELECTRICAL TECHNOLOGY

WHAT IS ELECTRICAL TECHNOLOGY

Electrical Technology focuses on the understanding and application of electrical and electronics principles. The subject focuses on three main areas of specialisation, namely;

1. Electrical (Power Systems)
2. Electronics
3. Digital Electronics

In the following section, the respective areas of specialisation are described and placed within the intended context.

1. ELECTRICAL (POWER SYSTEMS)

Electrical systems refer to applications of electricity where heavy current from mains supply is used in a number of applications. In Grade 10, the learner is introduced to direct current (DC) and domestic installations. The circuitry as it is found in a typical South African home, in accordance with the requirements of the SANS 10142 forms a major part of the learner's curriculum.

In Grade 11 the learner is introduced to light industrial single phase applications where motors and transformers are used. Programmable Logic Controllers (PLC) is introduced in Grade 11, and is continued in Grade 12.

The focus of the Grade 12 year in Electrical contextualizes the generation, distribution and application of three-phase power in motors, transformers as well as control using PLC. By the completion of the Electrical specialisation in Electrical Technology a learner will have knowledge of electrical heavy current in single and three phases from the supplier to the consumer with domestic, light and heavy industrial motor and control.

A learner in Electrical may opt to become an electrician and work in the manufacturing industry with specific focus on maintenance and repair of electrical installations and machinery. Further studies for such a learner will typically be along the lines of an FET college in conjunction with an internship at a local industry. Further studies could be pursued through a university for learners with the required subject combinations.

2. ELECTRONICS

Electronics as a specialization in Electrical Technology introduces the learner to analogue electronics utilizing mainly light current applications. In Grade 10 the learner will be introduced to the principles of electricity and current flow.

In Grade 11 the learner further explores discrete electronics through the examination of semiconductor devices and its various applications. The learner is introduced to instrumentation and how to use it to make measurements and subsequent conclusions based on observation.

Towards Grade 12 the learner is introduced to integrated circuits and how simple circuits are combined to form more complex circuitry for the purpose of establishing communications and control. A learner with Electrical Technology specializing in Electronics will be able to source solutions to problems using electronic applications and innovations made to existing circuits. The learner will be able to construct, test and commission electronic circuits.

Such a learner will typically opt for a career as a technician in light current, instrumentation, communication and even the entertainment industry. To become an artisan a learner will opt for studies at a FET college, in conjunction to following an internship at a related industry. Further studies for a learner with the required subject combinations will enable him/her to progress towards an electronic technician/technologist/engineer through a university.

3. DIGITAL ELECTRONICS

A learner taking Digital Electronics will have a strong interest in computers, programmable IC's, Boolean algebra, microcontrollers, system control, processors, and programming. In Grade 10 a learner in Digital Electronics is introduced to the principles of electricity and electronics, similar to an Electronics learner.

In Grade 11 the focus shifts more towards digital electronics and Boolean algebra. The learner is also introduced to communications as it forms a corner stone of digital systems. At the very same time the learner is introduced to a few aspects of motors and control using pulse width modulation which opens up the world of robotics and interfacing the digital world with the real world such as mechatronics.

In Grade 12 a learner is orientated towards integrated electronic devices that are "intelligent". In this instance the learner is taught how to program integrated circuits as a problem solving method to satisfy a need. The learner will be able to engage with basic robotics and mechatronics, setting a basis from which the learner can pursue a career in industrial electronics and control.

The digital electronics learner will typically pursue an engineering career with studies at a university directly following school, again with the required subject combinations for university access. Careers open to a learner includes digital engineering, manufacturing systems design, information technology programming and even the film industry through robotics and special effects in computer graphics and interfacing. Further studies for a learner with the required



subject combinations will enable him/her to progress towards an electronic technician/technologist/engineer through a university.

SPECIFIC AIMS

Electrical technology as a whole, aims to equip the learner with a firm foundation in electrical, electronic and digital principles.

Through the integrated completion of theoretical work, practical assessment tasks (PAT) and simulations the following skills are developed:

- Safe work practices
- Good housekeeping
- First aid practices
- Reading and interpreting circuit diagrams from symbols to application
- Sourcing components
- Constructing circuits
- Installation, testing and troubleshooting of circuits
- Taking measurements
- Workshop practice

ELECTRICAL TECHNOLOGY CONTENT OUTLINE

GRADE 10 TOPICS	GRADE 11 TOPICS	GRADE 12 TOPICS
Occupational Health and safety Responsibilities, Workshop Rules & Procedures	Occupational Health and safety introducing the OHS Act, housekeeping & personal safety	Occupational Health and safety The consequences of the OHS act, risk assessment, human rights in the workplace, work ethics and emergencies
Tools and measuring instruments Tools and how to use it	Tools and measuring instruments measuring instruments and how to use it	
Electric Circuits Draw single-phase circuits with reference to distribution and switching circuits	Single Phase ac Generation How electricity is generated.	Three Phase ac Generation Power in three phase systems, measurement and calculations
Magnetism Principles of magnetism and the relevant Laws.	Single-phase transformers induction, the operation of transformers and types of transformers	Three Phase transformers Principles of operation, calculations and application.

GRADE 10 TOPICS	GRADE 11 TOPICS	GRADE 12 TOPICS
	Single Phase motors The Universal motor, split phase motor and its application	Three Phase motors & starters Principle of operation, Testing and commissioning and starters
Principles of electricity introduction of electricity as the core of the subject	RLC The effect of AC on Series RLC Circuit	RLC The effect of AC on Series and parallel RLC Circuits
Protective devices Fuses and Fuse types, MCB's and earth leakage protection	Protective devices The Direct Online Starter and its application	
Electronic Components Basic electronic components and how it operates.	Semi-Conductor devices The diode, transistor, thyristor, DIAC and TRIAC and its application	
Power sources Basic power sources such as the battery and how it operates.	Power supplies Principle of operation of linear power supplies, series and shunt using regulation.	
	Amplifiers Principle of operation and application of Transistor amplifiers.	Amplifiers Principle of operation and application of Operational amplifiers.
Logic Boolean Logic and basic logic gates with its application	Logic Intermediate logic principles, using logic gates to express Boolean equations and solve simple problems.	Logic introduction of programmable logic control, application of Boolean Expressions and combinational logic networks
Communications Basic communication principles and modulation	Communications Radio communications, antennas, modes of modulation, transmitters and receivers.	



CAREER OPPORTUNITIES ELECTRICAL TECHNOLOGY

Electrical Technology unlocks a world of potential to any learner taking the subject. Due to the nature of electrical technology, it is easy and relatively cheap to setup and operate an electrical/electronic/digital workshop at home for the purpose of starting a business or to practice a hobby for personal gain.

Learners that opt for careers not related to the subject will have sufficient knowledge and skills at the end of Grade 12 to continue experimenting for the purpose of self-tuition and the practice of electrical technique.

Possible career and life experience opportunities that exist for learners with a foundation in Electrical Technology include amongst others the following:

- Electrical fitter
- Electrical or electronic engineer
- Electrical draughts person
- Electrical or electronic technician
- Electrical or electronic technologist
- Digital / Software Engineer
- Academic in the field of Electrical Technology
- Electronic mechanic
- Auto-electrician
- Electrician
- Radio Technician
- Cell Phone Technician
- Communications Technician
- PLC Programming Expert
- Electronics Programming Engineer
- Computer Technician
- Robotics Engineer
- Mechatronics Technician
- Installation Electrician
- Radio Amateur
- Electronic hobbyist Radio Control Enthusiast
- Production Manager
- Sound and Light Engineer

MECHANICAL TECHNOLOGY

WHAT IS MECHANICAL TECHNOLOGY?

Mechanical Technology focuses on concepts and principles in the mechanical (motor, mining, shipping, rail, power-generation, etc.) environment and on technological processes. It embraces practical skills and the application of scientific principles. This subject aims to create and improve the engineering and manufacturing environment to enhance the quality of life of the individual and society and ensure the sustainable use of the natural environment and resources.

SPECIFIC AIMS

- The learner in Mechanical Technology needs to be interested in any form of mechanical entities. It can be cars, planes, trains, welding, maintenance, etc.
- In order to be successful the learner also has to enrol preferably in Mathematics, Physical Science and Engineering Graphics and Design, as they all form part of the technical studying field.
- Mechanical Technology in essence is applied science, as the field of work includes trigonometry, Newton's laws and chemical equations when dealing with certain welding techniques, fuel combustion, fuel injection, cooling systems, etc.

Topics in Mechanical Technology are:

- Safety – Occupational Health and Safety (OHS) Act;
- Tools and equipment;
- Materials – ferrous and non-ferrous materials and alloys and the iron-carbon equilibrium diagram;
- Terminology – manufacturing processes with reference to lathes (diameter turning, taper cutting, screw cutting) and milling machines (cutting methods, dividing head, centring of cutter);
- Joining methods – permanent (welding) and semi-permanent (bolts, nuts and rivets) joints;
- Forces – forces, moments, Young's modulus, stress and strain;
- Maintenance;
- Systems and control:
- Mechanical – gears, belts, pulleys, power transmission, chains, clutches, cams, levers, etc.;
- Hydraulics – pistons, valves, Pascal's law;
- Pneumatics;
- Electrical wiring – starting and charging circuits; and
- Electronic applications – anti-lock braking system (ABS), fuel injection, air bag control, etc.;
- Engines – diesel and petrol, four and two stroke;
- pumps – centrifugal, water; and
- Turbines – super and turbo chargers, gas and steam turbines.

MECHANICAL TECHNOLOGY CONTENT OUTLINE

TOPIC	GRADE 10	GRADE 11	GRADE 12
SAFETY	Identification and prevention of hazardous conditions; good housekeeping; safe practices and good personal habits	OHS Act applicable to different tools and equipment	OHS Act applicable to different tools and equipment
TOOLS	Basic tools and equipment; measuring instruments	The principles and functions of purpose-made tooling and equipment such as dial indicators, micrometers, torque wrenches and stocks and dies	Principles and functions of advanced engineering equipment such as analyzers, testers, measuring instruments
MATERIALS	Ferrous metals and alloys; low, medium and high carbon steel; cast iron, grey cast iron, white cast iron; non-ferrous elements; non-ferrous alloy; thermo-plastic composites; thermo-hardened composites	Manufacturing of steel; properties of materials; enhancing properties of steel	The iron-carbon equilibrium diagram
TERMINOLOGY	Drilling machine; lathe (parts and functions, facing and centre drilling; diameter turning) Milling machine (parts and functions, movements of table and types of cutters)	Taper turning (lathe); dividing head (milling)	Screw cutting (lathe) and cut of gears and keyways (millings) and milling processes
JOINING	The uses of semi-permanent joining applications, bolts, nuts, studs, locking devices	Permanent (arc, gas, MIG), symbols, welding joints	Application of MIG welding, defects and tests (destructive and non-destructive)

TOPIC	GRADE 10	GRADE 11	GRADE 12
FORCES	Different types of forces, moments and stresses (solid bars) found in engineering components	System of forces (two or more), moments (two forces on a beam) and stresses (hollow pipes) found in engineering components	System of four forces acting, beams for a uniform load, stress and strain and Young's modulus
MAINTENANCE	The effect of lack of maintenance on operating systems; friction and types of maintenance	Analysis of the causes of malfunction of operating systems and alignment on vehicles	Properties of lubricants, grading of oil, maintenance on clutches, belt and chain drives
SYSTEMS AND CONTROL	<p>Mechanical: identify different types of gears, pulleys, belts, etc.</p> <p>Hydraulics / pneumatics: symbols and diagrams on simple hydraulic systems</p> <p>Electrical/electronic control: Warning lights, sender units, gauges</p>	<p>Mechanical components: advantages, disadvantages, velocity calculations and operating principles of different drives</p> <p>Hydraulics/Pneumatics: use, description and calculations</p> <p>Electrical / Electronic Control: basic operating principles of ignition timing, fuel injection, charging and starting circuits</p>	<p>Mechanical: simple calculations related to power transmission systems on gears, pulleys and belts</p> <p>Hydraulics: basic calculations on double-acting pistons and reservoirs (hydraulic jack/lift) and Boyle's law</p> <p>Electrical/Electronic Control: basic operating principles of electronic control systems (ECU), ABS, air bag, central locking</p>
ENGINES, PUMPS AND TURBINES	Four stroke and two stroke petrol and diesel engines, components of engines	Operating principles of pumps	Operating principles of gas and steam turbines and turbo and super chargers.



CAREER OPPORTUNITIES IN MECHANICAL TECHNOLOGY

- Apprenticeship as a motor mechanic, fitter and turner, welder, boiler maker, tractor mechanic, etc.
- Engineering studies in the fields of aviation, air-conditioning, motor cars, engines, ship building, power systems, electrical power stations, etc.
- Studies at Higher Education Institutions (HEI's) and Skills training institutions with reference to the various mechanical streams.
- Entering the world of work as an entrepreneur in various fields such as precision machining, programming of lathes and milling machines, fitment of accessories to cars and trucks to enhance performance, maintenance of many different mechanical installations.
- Research and development of new and current entities in the mechanical field of work.
- Mechanical Technology does not have the distinction of being a grade 12 exemption subject; it has the advantage of giving the learner the background of what is expected from them when enrolling in any mechanical study opportunities.

CIVIL TECHNOLOGY

WHAT IS CIVIL TECHNOLOGY?

Civil Technology focuses on concepts and principles in the built environment and on the technological process. It embraces practical skills and the application of scientific principles. This subject aims to create and improve the built environment to enhance the quality of life of the individual and society and to ensure the sustainable use of the natural environment.

The subject focuses on three main areas, namely:

- Civil Services;
- Construction; and
- Woodworking

Main topics in Civil Technology:

- Safety
- Materials
- Equipment
- Graphics And Communications
- Terminology
- Applied Mechanics
- Construction
- Civil Services
- Quantities
- Joining

SPECIFIC AIMS

The aim of the subject Civil Technology is to develop the skills levels of learners from Grade 10-12 to such an extent that they will be able to enter a career pathway at a Further Education and Training College or a university immediately after obtaining the National Senior Certificate. Learners will be ready to enter into learnerships or apprenticeships that will prepare them for a trade test.

Through the integrated completion of theoretical work and the practical assessment tasks (PAT) skills in respect of the following will be developed:

- Safe working practices
- Good housekeeping
- First aid practices
- Interpretation of working drawings
- Erection of structures
- Working with accurate measurements
- Workshop practice

Knowledge of subject principles, combined with applied skills, equips the Civil Technology learner with a unique set of skills, placing her or him apart from other learners and in a category much desired by industry, tertiary institutions and entrepreneurs. Learners with Civil Technology as a subject fare markedly better during the first two years at tertiary level when studying engineering than learners without this background, giving them an advantage when studying engineering.

CIVIL TECHNOLOGY CONTENT OUTLINE

TOPIC	GRADE 10	GRADE 11	GRADE 12
SAFETY	Occupational Health and Safety Act (OHSA) - Personal and general safety for power and hand tools. Safe storage of material and equipment	OHSA - Personal and general safety. Safe storage of material. Fire-fighting and prevention of fires	Application and regulation of OHSA pertaining to personal safety, hand and power tools
GRAPHICS AND COMMUNICATIONS	Line work, freehand sketches of tools, orthographic projections, introduction to CAD, symbols used in building drawings. Section through sub-structure of a dwelling	Sketches of building components, vertical section of building and building components, isometric views of parts of buildings. Section through super-structure of a dwelling. CAD application	Sketches of building components, vertical section of building and building components, isometric views of parts of buildings. Section through entire building. Completion of plan for a dwelling. CAD application
MATERIALS	Properties of materials: metals; timber; concrete and concrete products; bricks and plastics	Use of materials in the built environment	The sustainability of materials according to their appropriate use and nature (preservation, painting, curing, electroplating, powder-coating and galvanising)
EQUIPMENT	Use, safe handling and care of hand and power tools: basic site equipment, measuring and setting out tools, bricklaying tools, woodwork tools	Use, safe handling and care of hand and power tools: plastering tools, construction machinery and plumbing tools	Use, safe handling and care of hand and power tools: specialised tools and construction machinery
TERMINOLOGY	Correct application of terminology in every lesson	Correct application of terminology in every lesson	Correct application of terminology in every lesson



CAREER OPPORTUNITIES IN CIVIL TECHNOLOGY

Career and life experience opportunities for learners with a foundation in Civil Technology include those of:

- Carpenter And Joiner
- Bricklayer
- Tiler
- Painter
- Plumber
- Drain layer
- Roof Specialist
- Cabinet Maker
- Shutter Hand
- Building Inspector
- Quantity Surveyor
- Architect
- Draughtsman
- Building Surveyor
- Building Technician
- Civil Engineer
- Structural Engineer
- Civil Technology Teacher

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