basic education
Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

2023/24 ANNUAL TEACHING PLANS: ELECTRICAL TECHNOLOGY (DIGITAL ELECTRONICS): GRADE 11 (TERM 1)

TERM 1	WEEK 1	WEEK 2	WEEK 3	WEEK 4	WEEK 5	WEEK 6	WEEK 7	WEEK 8	WEEK 9	WEEK 10	WEEK 11
CAPS TOPICS	**Occupational health and safety**	**Tools and measuring instruments**	**Waveforms**	**Waveforms**	**Waveforms**	**Waveforms**	**RLC**	**RLC**	**RLC**	**PAT consolidation, revision and assessment**	**PAT consolidation, revision and assessment**
TOPICS, CONCEPTS, SKILLS AND VALUES	**Occupational health and safety** • Basic introduction to regulations - What are regulations? - How to use regulations - Impact of regulations on the workshop - Introduction and purpose of the regulations • General Machinery Regulations 1988 - Supervision of machinery - Safeguarding of machinery - Operation of machinery - Working on moving or electrically alive machinery - Devices to start and stop machinery - Reporting of incidents in connection with machinery • Electrical Machinery Regulations 1988 - Safety equipment - Electrical control gear - Switchboards - Portable electric tools - Earthing - Conductors	**Testing equipment** - Function generator and oscilloscope - External parts and their functions - Principle of operation - Application - Care - Maintenance - Calculation on the oscilloscope - Time - Frequency - Phase difference - Maximum value **Practical:** Basic use of the oscilloscope to display waveforms taken from the function generator **Practical:** Determine voltage and frequency values as displayed on the oscilloscope. (Note: Oscilloscope does not measure and display current)	**Introduction to waveforms** - Uses of waveforms - Different types of waves - Waveforms and their applications - Square wave - Saw tooth wave - Triangular wave - Rectangular wave - Radio wave **Definition, symbol & unit of:** - The sinusoidal wave - Instantaneous value - Maximum value, minimum value - Peak to peak value - RMS value Vrms = 0.707 x Em - Average value over half cycle (Vavg = Vmax x 0.637) - Time period - Frequency - Duty cycle - Form factor - Concept of phase and phase difference - Harmonic frequencies (concept only) - Difference between a sound wave and an electromagnetic wave (concept only – self-propagating vs. medium needed) **Demonstration:** Function generator and the oscilloscope used to measure and display waveforms	**Pulse technique** - Pulse polarity - Pulse time - Rise time, fall time - What is a clock pulse, leading edge, trailing edge? **Calculations** - Pulse time - Pulse frequency - Rise time, fall time - Period and frequency - λ (wavelength) & frequency **Practical:** Set up and measure different waveforms generated by the function generator on the oscilloscope	**Wave Shaping Circuits** - Diode using discrete components only - Clipping circuits (positive clipping only) - Simple series - Series biased - Simple parallel - Biased parallel - Clamping circuits (positive clamping only) • Clamping circuit – diode • Clamping circuit – Zener diode - Integrator & differentiator - No calculations - Input and output waveforms on oscilloscope • Construction on a breadboard • Measurement of output waveform **Practical:** Construct each type of clipping and clamping circuit on a breadboard using diodes	- Clamping circuits (positive clamping only) • Clamping circuit – diode • Clamping circuit – Zener diode - Integrator & differentiator • No calculations • Input and output waveforms on oscilloscope • Construction on breadboard • Measurement of output waveform **Practical:** Construct each type of clipping and clamping circuit on a breadboard using diodes	**Effect of alternating current on resistors, inductors and capacitors (RLC)** - Components in series circuits only - All applicable calculations - Relevant to the theory to be completed - Emphasis will be on circuits containing ONE resistor, ONE capacitor and ONE inductor - Wave representation - Phasor diagram - Inductive reactance $XL = 2\pi fL\ (\Omega)$ - Capacitive reactance $Xc = \frac{1}{2\pi fC}(\Omega)$ - Effect of frequency changes on XL and XC **Demonstration:** Show phase difference between RL and RC	- Impedance $OZ = \sqrt{R^2 + (X_L - X_C)^2}\ (\Omega)$ - Scalar: representation of the impedance triangle - power o $P = V \times I \cos\theta\ (Watt)$ - Power factor O $\cos\theta = \frac{R}{Z}$ O $\cos\theta = \frac{V_R}{V_Z}$ - Phase angle O $\theta = \cos^{-1}\frac{R}{Z}\ (Deg)$ O $\theta = \cos^{-1}\frac{V_R}{V_Z}\ (Deg)$	- Natural resonance - Effect of frequency changes on the - Impedance and current flow - Resonance with its characteristic - Curves - Q factor - Bandwidth - Frequency changes **Calculations** - Series combination circuits containing ONE resistor, ONE capacitor and ONE inductor - Phasor and wave representation - Resonance - Bandwidth - Q factor	**Simulation 1:** **Design: Part 1** - Circuit diagram drawn - Component list completed	**Simulation 1:** **Design: Part 1** - Circuit diagram drawn - Component list completed

TERM 1	WEEK 1	WEEK 2	WEEK 3	WEEK 4	WEEK 5	WEEK 6	WEEK 7	WEEK 8	WEEK 9	WEEK 10	WEEK 11
	Safety - What are ergonomics? (Workplace conditions, comfort – everything has a place and everything is in its place) - Unsafe actions - Unsafe conditions - Dangerous practices - Housekeeping principles - Signs in the workshop - Information signs - Safety signs - Prohibition signs - Fire safety signs - Regulatory signs - Designated areas **Practical:** Identification of safety signs and safety gear - Revision of emergency procedures (Grade 10) **Practical:** Clean the workshop (weekly activity) **Personal Safety** • Protective gear for machinery • Personal protection equipment • Eye protection • Coveralls, overalls • Hearing protection **Practical:** Use personal protection equipment (during practical sessions)										
INFORMAL ASSESSMENT: REMEDIATION	Classwork, case studies, worksheets, homework, theory and practical, etc.										
SBA (FORMAL)	**Assignment** **PAT simulation 1 completed** The legislation governing workplaces in relation to COVID – 19 is the Occupational Health and Safety Act, Act 85 of 1993, as amended, read with the Hazardous Biological Agents Regulations. Section 8 (1) of the Occupational Health and Safety (OHS) Act, Act 85 of 1993, Safe work practices are types of administrative controls that include procedures for safe and proper work used to reduce the duration, frequency, or intensity of exposure to a hazard. Examples of safe work practices for SARS-CoV-2 include. Requiring regular hand washing or using of alcohol-based hand rubs. Learners and teachers should always wash hands when they are visibly soiled and after removing any PPE. Keep safe distances and wear a mask at all times.										

2023/24 ANNUAL TEACHING PLANS: ELECTRICAL TECHNOLOGY (DIGITAL ELECTRONICS): GRADE 11 (TERM 2)

TERM 2	WEEK 1	WEEK 2	WEEK 3	WEEK 4	WEEK 5	WEEK 6	WEEK 7	WEEK 8	WEEK 9	WEEK 10	WEEK 11
CAPS TOPICS	**Semiconductor devices**	**Semiconductor devices**	**Semiconductor devices**	**Semiconductor devices**	**Semiconductor evices**	**Semiconductor devices**	**Semiconductor devices**	**Semiconductor devices**	**PAT consolidation and revision**	**PAT consolidation, revision and assessment**	**PAT consolidation, revision and assessment**
TOPICS, CONCEPTS, SKILLS AND VALUES	**Introduction to semiconductor devices** - Component data - Where to source data on all types of electronics components - How to read data sheet - Pin configuration - Typical operating values - Working temperature - Equivalent components - Packages (dual in line, TO92, basic packages) - Through-hole components vs surface-mount devices	**Semiconductors** - Electron flow vs conventional flow - Semiconductors & solid state - Silicon vs germanium - Doping - P & N material - majority Carriers, minority carriers **PN Diode** - Construction of a PN diode - Depletion layers - Biasing – forward and reverse - Characteristics curve & symbol - Calculation of diode load line	**Practical:** Diode load line **Zener diode** - Construction - Principle of operation - Forward biasing - Reverse biasing - Avalanche breakthrough vs. controlled breakthrough - Zener as a voltage regulator - Characteristics curve & symbol - Zener calculations **Practical:** Determine the value of the series resistor for a Zener diode	**The NPN transistor** - Construction - Principle of operation - Purpose of biasing & thermal runaway - Forward biasing - Reverse biasing - Base curve - Emitter output curve - Regions of operations (saturation, active and off) - The transistor DC load line - Transistor power related to the load line (VCC and VCE) - Influence of the DC load line on the characteristics of the transistor - Symbol	**Application of transistors** - Transistor as a switch - Transistor as an amplifier (mention only – circuits to follow under amplifiers) - Transistor gains - Current gain - Voltage gain	**Practical:** Determine the DC load line of the transistor **Practical:** Build a circuit using the transistor as a switch	**The PNP transistor** - Construction - Principle of operation - Relation to NPN - Symbol - Application – simple circuits only **Practical:** Build a circuit using the transistor as a switch	**Thyristor – SCR** - Construction - Principle of operation - Purpose of biasing - Symbol - Characteristics curve - Application (relaxation oscillator, phase control, switch mode application, DC-DC converter (buck, boost) - Circuit diagram **Practical:** Construct a relaxation oscillator and show waveform on oscilloscope **Practical:** Construct a light dimmer circuit	**Simulation 2**	**Design: Part 1** - Circuit description filled in - Tools list for circuitry populated - Learner's own - PCB planning, design included in the file	**Design: Part 1** - Circuit description filled in - Tools list for circuitry populated - Learner's own - PCB planning, design included in the file
ASSESSMENT	**INFORMAL ASSESSMENT:** REMEDIATION	Classwork, case studies, worksheets, homework, theory and practical, etc.									
	SBA (FORMAL)	Controlled test **PAT simulation 2 completed** The legislation governing workplaces in relation to COVID-19 is the Occupational Health and Safety Act, Act 85 of 1993, as amended, read with the Hazardous Biological Agents Regulations. Section 8 (1) of the Occupational Health and Safety (OHS) Act, Act 85 of 1993, Safe work practices are types of administrative controls that include procedures for safe and proper work used to reduce the duration, frequency, or intensity of exposure to a hazard. Examples of safe work practices for SARS-CoV-2 include requiring regular hand washing or using of alcohol-based hand rubs. Learners and teachers should always wash hands when they are visibly soiled and after removing any PPE. Keep safe distances and wear a mask at all times.									

2023/24 ANNUAL TEACHING PLANS: ELECTRICAL TECHNOLOGY (DIGITAL ELECTRONICS): GRADE 11 (TERM 3)

TERM 3	WEEK 1	WEEK 2	WEEK 3	WEEK 4	WEEK 5	WEEK 6	WEEK 7	WEEK 8	WEEK 9	WEEK 10	WEEK 11
CAPS TOPICS	**Semiconductor devices**	**Semiconductor devices**	**Logics**	**Logics**	**Logics**	**Logics**	**Logics**	**Logics**	**Logics**	**Revision and assessment**	**Revision and assessment**
TOPICS, CONCEPTS, SKILLS AND VALUES	**TRIAC** - Construction - Principle of operation - Purpose of biasing - Symbol - Characteristics curve - Application (relaxation oscillator, phase control, switch mode application, DC-DC converter (buck, boost) - Circuit diagram **Practical:** Construct a light dimmer circuit	**DIAC** - Construction - Principle of operation - Purpose of biasing - Symbol - Characteristics curve - Application (relaxation oscillator, phase control, switch mode application, DC-DC converter (buck, boost) - Circuit diagram application	**Logic gate theory** - Identify and interpret logic gates and symbols ➢ NOT ➢ AND ➢ NAND ➢ OR, NOR ➢ X-OR, X-NOR - Apply logic gates with a maximum of three inputs - Truth table - Boolean expression Following theory, practical combination circuits to be built Converting a logic circuit to a Boolean expression	**Boolean algebra** - Apply commutative and distributive laws - Product of sums (POS) - Sum of products (SOP)	**De Morgan's theorem** - Combinational, complex circuits ➢ Half and full adder ➢ Three input alarm ➢ Complex circuits of choice	**Karnaugh maps** - How to do Karnaugh map - Simplifying Boolean expressions (max 4 operands)	**Logic probe** - Positive & negative logic - Active low - Active high **Practical:** Test logic gate outputs using a logic probe	**Resistor transistor logic** - NPN transistor only - Input gates only - AND, OR and NOT gates in RTL only **Practical:** Construct RTL logic gates using transistors and resistors (AND, OR and NOT)	**Transistor logic** - Explain why TTL, CMOS logic is used - Differences between TTL and CMOS - Advantages and disadvantages - Application of TTL – no practical circuits of TTL **Logic ICs practical circuits** - 40, 70 and 74 series - NAND gate combinational, equivalent circuits - NOR gate combinational, equivalent circuits **Practical:** Construct logic circuits using logic ICs	**Simulation 3:** **Design: Part 2** - Enclosure design completed and included in the file - Unique name written down - Logo designed - Building the enclosure and installing circuit in the enclosure	**Design: Part 2** Enclosure design completed and included in the file - Unique name written down - Logo designed - Building the enclosure and installing circuit in the enclosure
ASSESSMENT	**INFORMAL ASSESSMENT:** REMEDIATION	Classwork, case studies, worksheets, homework (theory and practical work)									
	SBA (FORMAL)										**Term test**
		PAT simulation 3 **Controlled test** The legislation governing workplaces in relation to COVID-19 is the Occupational Health and Safety Act, Act 85 of 1993, as amended, read with the Hazardous Biological Agents Regulations. Section 8 (1) of the Occupational Health and Safety (OHS) Act, Act 85 of 1993. Safe work practices are types of administrative controls that include procedures for safe and proper work used to reduce the duration, frequency, or intensity of exposure to a hazard. Examples of safe work practices for SARS-CoV-2 include requiring regular hand washing or using of alcohol-based hand rubs. Learners and teachers should always wash hands when they are visibly soiled and after removing any PPE. Keep safe distances and wear a mask at all times.									

2023/24 ANNUAL TEACHING PLANS: ELECTRICAL TECHNOLOGY (DIGITAL ELECTRONICS): GRADE 11 (TERM 4)

TERM 4	WEEK 1	WEEK 2	WEEK 3	WEEK 4	WEEK 5	WEEK 6	WEEK 7	WEEK 8	WEEK 9	WEEK 10
CAPS TOPICS	**Sensors and transducers**	**Sensors and transducers**	**Sensors and transducers**	**Sensors and transducers**	**Sensors and transducers**	**PAT moderation and revision**	**Revision**	**Exams**	**Exams**	**Exams**
TOPICS, CONCEPTS, SKILLS AND VALUES	**Introduction to sensors and transducers** - Definition of sensors and transducers - Piezo electric effect - Wheatstone bridge principles of resistance measurement	**Functional operation of sensors and transducers:** Sound - Dynamic microphone - Electret microphone **Practical:** Connect a microphone to an amplifier and the output of the amplifier to an oscilloscope and display on screen - Light - The LDR - Photodiode - Phototransistor opto-coupler	**Practical:** Use a Wheatstone bridge with a sensor to show changes in light	- Temperature - The thermistor - Thermocouple – working principle and special conditions for use (not a linear resistive output – to be used with a lookup table) **Practical:** Use a Wheatstone bridge with a sensor to show changes in temperature Other types of sensors – application only - Gas, humidity sensor - Load cells, strain sensors - Proximity sensors	**Practical:** Use a Wheatstone bridge with a sensor to show changes in proximity of metal, humidity	Finalising PAT portfolio and project for moderation in the workshop Revision term 1 and term 2 content	Finalising PAT portfolio and project for moderation in the workshop Revision term 3 and term 4 content			
ASSESSMENT	**INFORMAL ASSESSMENT:** REMEDIATION	Classwork, case studies, worksheets, homework, theory and practical, etc.								
	SBA (FORMAL)	**Examination**								