BASIC ELECTRICITY/ APPLIED ELECTRICITY

PREAMBLE

This examination syllabus has been evolved from the Senior Secondary School Electricity curriculum. It is designed to test candidates' knowledge and understanding of electrical and electronic principles, maintenance and repair of domestic and industrial equipment and safe working procedures. The examination syllabus does not replace the curriculum.

OBJECTIVES

The objective of the syllabus is to test candidates':

(1) knowledge and understanding of the basic concepts and principles of Basic Electricity/Applied Electricity;

(2) ability to use tools and equipment in the maintenance and repair of electrical/electronic devices;

(3) understanding of the principle of operation and the application of simple electrical/electronic devices;

(4) understanding of safe working procedures and safety precautions in domestic and industrial installation.

EXAMINATION SCHEME

There will be three papers, Papers 1, 2 and 3 all of which must be taken. Papers 1 and 2 will be a composite paper to be taken at one sitting.

PAPER 1: will consist of fifty multiple-choice objective questions to be answered in 1 hour for 50 marks.

PAPER 2: will consist of three sections: Sections A, B and C as follows:

SECTION A will be compulsory for all candidates. It will consist of four questions out of which candidates will be required to answer any three.

SECTION B will be for candidates in Ghana only. It will consist of three questions out of which candidates will be required to answer two.

SECTION C will be for candidates in Nigeria, Sierra Leone and The Gambia only. It will also consist of three questions out of which candidates will be required to answer two.

Thus, candidates will be required to answer five questions in all. The paper will last 1 hour and carry 50 marks.

PAPER 3: will be a practical paper of two experiments both of which are to be carried out by candidates in 3 hours for 100 marks.

DETAILED SYLLABUS

SECTION A

(For all candidates)

TOPIC	NOTES
1. DIRECT CURRENT CIRCUIT THEORY	
Structure of matter	Qualitative treatment of the structure of atoms in relation to electric current.
Resistors	Types of resistors. Resistor colour code. Resistors in series and parallel. Power rating of resistors.
Conductors and insulators.	Definition, examples and characteristics.
Ohm's law and Kirchhoff's laws	Qualitative treatments only.
Power and energy	Treatment should include calculations.
2. MAGNETIC FIELD AND ELECTROMAGNETISM	
Fundamentals of magnetism	Types of magnet. Magnetic properties of materials: magnetic flux, magnetic flux density, permeability, magnetomotive force and reluctance.
Concept of Electric field	Electric field and properties: electric flux, electric flux density, electric field strength, permittivity and dielectric constant, potential gradient. Comparison between magnetic and electric circuits
Capacitors	Types of capacitor. Capacitance and dielectric. Charge on capacitor, relationship between charge and applied voltage of a capacitor. Application of capacitors. Voltage rating.

Electromagnetic field	Series and parallel connection. Energy stored in a capacitor ($E = \frac{1}{2}QV = \frac{1}{2}CV^2$): simple calculations. Magnetic field around a current-carrying conductor. Fleming's Right Hand Rule Force on a current-carrying conductor in a magnetic field ($F = BIL\sin\theta$). Lenz's law and Faradays law. Emf induced in a coil ($E = BLV\sin\theta$) Simple calculations involving force and e.m.f. only.
Self and Mutual Induction	Qualitative treatment of self and mutual induction. Energy stored in a coil ($E = \frac{1}{2}LI^2$). Application of electromagnetism as found in electric bell, security alarm system, solenoid, loudspeaker, buzzer, moving-coil instruments etc.
3. MEASURING INSTRUMENTS Moving-coil instrument	Construction, advantages and disadvantages. Conversion of moving-coil instrument to ammeter and voltmeter. Calculations of shunts and multipliers.
Moving-iron instrument	Construction, principles of operation, advantages and disadvantages.
Digital instrument	Multimeter, voltmeter, ammeter etc. Advantages and disadvantages.
4. DIGITAL ELECTRONICS Binary number	Conversion of decimal numbers to binary numbers and vice versa.
Logic gates	Series connection of switches - AND gate, parallel connection of switches - OR gate and inverter - NOT gate. Truth table for logic gates. General symbols for AND, OR, NOT, NAND and NOR gates. Boolean expression.
5. ALTERNATING CURRENT	

CIRCUIT THEORY Generation of e.m.f. in a single turn coil	Plotting of labelled sinusoidal waveform for a complete cycle.
A.C. quantities	A.C quantities (r.m.s., peak and average values, form factor, cycle, period and frequency)
RLC circuits	Solution of problems involving RL, RC and RLC series circuits. Conditions for resonance. Phasor diagram of series resonance.
6. TRANSFORMERS Types of transformer	Transformer construction Type based on (i) construction (shell and core) and (ii) function (current and voltage).
Principles of operation of a transformer	Operation and transformation ratio
Losses and temperature rise in transformers	Transformer losses (copper and iron) Effect of losses and temperature rise in a transformer. Qualitative treatment only.
Efficiency of transformers	Losses and efficiency of transformer
Cooling of transformers	Methods of cooling. Need for cooling.
7. POWER SUPPLY Power supply units	Power supply units: dry cell, solar cell, cadium cell and accumulator. Block diagram of d.c. power supply. Functions of blocks of power supply.
Rectification	Half-wave and full-wave rectifications. Filtration and stabilization.
8. ELECTRICAL MACHINES A.C. motors (Single phase)	Types of single phase motor: split-phase, capacitor-start, capacitor-run. Application of single-phase motors.
Alternators	Principles of operation, parts and types. Relationship of speed, number of poles and frequency $f = \frac{}{}$ (Hz)
A.C. motors (Three phase)	Principles of operation, parts, type and application

	Methods of starting: direct-on-line, star delta and auto transformer.
D.C. generators	Principles of operation, parts and methods of connecting field windings.
D.C. motors	Principles of operation, parts, types (shunt, compound, series) and application.
9. ELECTRICAL ENERGY SUPPLY Generating station	Methods of generating electrical power: diesel engine, steam engine, hydro-electric, nuclear, gas turbine.
10. ELECTRICAL WIRING Electrical installation	Types of wiring: surface, conduit, trunking, ducting. Selection of materials, tools and accessories. Application of IEE wiring regulation regarding domestic installation.
Wiring	Cables and accessories. Current-carrying capacity of cable. Wiring of lighting and socket outlets and connection of plugs. Conduit, surface, trunking and ducting installations.
Protection	Protective devices Fuses and circuit breakers Discrimination of protective devices
Earthing	Reasons for earthing. Methods of earthing. Earth loop impedance.
Maintenance, Fault diagnosis and Repairs	Types of fault: short circuit, open circuit and earth leakage. Methods of diagnosing and repair of faults in an installation and equipment such as fluorescent fitting, electric iron, electric fan, blender etc.
Testing of an installation	Continuity test, insulation resistance test, earth leakage test and polarity test.
General Workshop Safety	Application of electrical safety regulations.

SECTION B

(For candidates in Ghana only)

TOPIC	NOTES
11. ELECTRON EMISSION	
Electron emission	Methods of emitting electrons: Thermionic emission, photo emission, secondary emission and field emission.
Thermionic emission	Functions of electrodes, parameters and application.
Cathode Ray Tube(CRT)	Functions of electrodes in CRT.
12. SEMICONDUCTOR	
Theory	Properties of semiconductor materials. Differences between n-type and p-type semiconductor materials.
Diode	Circuit symbol. PN junction diode. Barrier potential. Forward and reverse bias for a pn junction diode. Characteristics of a pn diode. Application of pn junction diode.
Transistor	Bipolar transistor: two pn junction devices (npn and pnp). Configuration of bipolar transistor: CC, CB and CE. Principles of operation and mode of connection of the three configurations of a transistor. Characteristics of an npn transistor (common emitter). Unipolar transistor: p-channel and n-channel of field effect transistor (JFET). Principles of operation of JFET. Semiconductor devices and their application: diac, triac, SCR, LED and zener diode. Application of a photo transistor

	Integrated circuits: simple integrated circuits and their uses.
13. COMMUNICATION	
Electromagnetic waves	Characteristics of radio waves.
Modulation	Amplitude and frequency modulation and their waveforms.
	Advantages of frequency modulation (F.M.) over amplitude modulation (A.M.).
Amplifiers	Classifications: class A, class B, class AB and class C. Application and efficiency of an amplifier.
Operational amplifiers	Properties and construction of an ideal operational amplifier. Inverting and non-inverting op-amp.

SECTION C

(For candidates in Nigeria, Sierra Leone and The Gambia)

TOPIC	NOTES
14. ELECTRICITY TRANSMISSION AND DISTRIBUTION	
TRANSMISSION	Layout diagram of high voltage overhead transmission system. Treatment of main components (towers, insulators and conductors) and functions. Detailed treatment of components not required. Operating voltage levels for transmission lines (132 kV and 330 kV) and the need for high voltage system should be emphasized.
DISTRIBUTION OF ELECTRICITY	Layout diagram and main components of electricity distribution. Functions of substation components (transformers, feeders etc.)

15. MAINTENANCE AND REPAIR OF VARIOUS ELECTRICAL APPLIANCES Maintenance Maintenance and repair of electrical appliances	Types (predictive, preventive and corrective) Common faults that occur in electrical appliances (blender, electric iron, electric kettle, toaster, fluorescent lamps etc) such as short circuit, open circuit, earth fault etc.