MINISTRY OF EDUCATION

Republic of Ghana

TEACHING SYLLABUS FOR ELECTRONICS (SENIOR HIGH SCHOOL 1-3)

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September 2010

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RATIONALE FOR TEACHING ELECTRONICS

The demands and challenges of the rapidly changing technological advances and the electronic revolution engulfing all of us make it imperative for students to acquire the needed knowledge and skills to deal with the demands of this emerging trend. The immediate need and focus of our education system is to train a large corps of students in the application of electronic engineering principles and techniques for solving practical electronic problems in their daily lives as well as providing them with sound foundation for studies in electronic engineering. It is envisaged that students will be encouraged to pursue this course to enable the nation produce the requisite human resource for the growing industrial base in the country.

The study of electronics provides students with broad understanding of the technology of manufacturing, maintenance and repair of domestic and industrial electronic equipment. The course offers valuable foundation in knowledge and skills for students who may wish to get into electronic-related vocations or pursue further training after completing Senior High School (SHS).

GENERAL AIMS

This syllabus is designed to assist students to:

a. acquire knowledge and understanding of the basic concepts and principles of electronics
b. use electronic tools and equipment efficiently for practical work
c. acquire problem solving skills through the use of the design process
d. observe safe and effective working procedures and precautions
e. apply moral principles in work situations in the field of electronics

SCOPE OF CONTENT

This course covers:

1. Concepts in Electronics
2. Direct Current Circuit Theory
3. Magnetic Field
4. Electric Field
5. Health, Safety and Protection
6. Electron Emission and Thermionic Devices
7. Measurements and Instruments
8. Electro Magnetism
9. Alternating Current Circuit Theory
10. Semiconductor Diodes

11. DC Power Supply
12. Bipolar, Unipolar Transistor and other Semiconductors
13. Amplifiers
14. Digital Electronics
15. Oscillators
16. Communication
17. Multivibrators
18. Digital Electronics
19. Control Systems

PRE – REQUISITE SKILLS AND ALLIED SUBJECTS

Students must be proficient in English, Mathematics and Physics.

ORGANIZATION OF THE SYLLABUS

The Syllabus has been structured to cover three years of the Senior High School Programme, SHS1-3. Each year's work consists of a number of sections with each section comprising a number of units. The syllabus is presented in the following pages

STRUCTURE AND ORGANISATION OF THE SYLLABUS

SHS 1	SHS 2	SHS 3
ELECTRONICS	**ELECTRONICS**	**ELECTRONICS**
SECTION 1: INTRODUCTION TO ELECTRONICS (Pg.1) Unit 1 Concepts of Electronics and Electricity Unit 2 Nature of Electricity **SECTION 2: HEALTH, SAFETY AND PROTECTIO (Pg.2)** Unit 1 Protective Devices Unit 2 General Safety Unit 3 Fire Safety	**SECTION 1: ELECTROMAGNETISM (Pg.9 - 11)** Unit 1 Electromagnetic Field Unit 2 Electromagnetic Induction Unit 3 Self and Mutual Induction Unit 4 Transformer **SECTION 2: MEASUREMENTS AND INSTRUMENTS (Pg.12 - 13)** Unit 1 Moving Coil Instrument Unit 2 Moving Iron Instrument Unit 3 Digital Multimeter Unit 4 Cathode Ray Oscilloscope (CRO)	**SECTION 1: DIGITAL ELECTRONICS (Pg.26 - 27)** Unit 1 Binary Numbers Unit 2 Logic Gates Unit 3 Combinational Logic Gates Unit 4 Sequential Logic Gates **SECTION 2: OSCILLATORS (Pg.28)** Unit 1 Oscillators **SECTION 3: MULTIVIBRATORS (Pg.29)** Unit 1 Non Sinusoidal Oscillators

TIME ALLOCATION

Electronics is allocated 6 periods a week on the time table. The number of periods, number of teaching weeks in the year etc., are indicated in the chart below.

Year	No. of periods per week	No. of teaching weeks/year	Total periods in a year	Total hours in a year
1	6	36	216	144
2	6	36	216	144
3	6	24	144	96
			576	384

SUGGESTIONS FOR TEACHING THE SYLLABUS

Practical activity is strongly emphasized in order that students would be able to see, handle and use the materials, processes and equipment used in the electronic industry. Most of the teaching should take place in an adequately equipped workshop or laboratory, and should take the form of practical and experimental work requiring active student participation rather than passive observation.

Materials and Equipment

Lists of materials and equipment for teaching electronics are provided at the end of the syllabus.

General Objectives

General Objectives have been listed at the beginning of each Section. The general objectives specify the skills and behaviours the student should acquire after learning the units of a section. Read the general objectives very carefully before you start teaching the section. After teaching all the units of the section go back and read the general objectives again to be sure you have covered the objectives adequately in the course of your teaching.

Sections and Units
The syllabus has been planned on the basis of sections and units. Each year's work has been divided into sections. A section consists of a fairly homogeneous body of knowledge within the subject. Within each section are Units. A unit consists of a more related body of knowledge and skills. The teacher is expected to teach the total number of sections and associated number of units prescribed for the year and plan the lessons for each term such that the work in all the Sections and Units for each particular class will be adequately completed by the end of the school year. Each section of the syllabus is structured in five columns. The five columns are as follows:

- Units
- Specific Objectives
- Content
- Teaching and Learning Activities
- Evaluation

A description of the contents of each column is as follows:

COLUMN 1 - UNITS

The Units in Column 1 are divisions of the major topics of the Section. You are expected to follow the unit topics according to the linear order in which they have been presented. However, if you find out at some point that teaching and learning in your class will be more effective if you switch to another unit before coming back to the unit in the sequence, you are encouraged to do so.

COLUMN 2 - SPECIFIC OBJECTIVES

Column 2 shows the specific objectives for each Unit. The specific objectives begin with numbers such as 1.3.5 or 2.2.1. These numbers are referred to as "Syllabus Reference Numbers." The 1st digit in the syllabus reference number refers to the section; the 2nd digit refers to the unit, while the 3rd digit refers to the rank order of the specific objective. For instance, 1.3.5 means: Section 1 (of the appropriate year's syllabus); Unit 3 (of Section 1) and Specific Objectives 5 of Unit 3 of Section 1.

COLUMN 3 - CONTENT

The 3rd column of the syllabus presents a selected body of information that you will need to use in teaching the particular Unit. In some cases, the content presented is quite exhaustive. In some cases, the content has been made skeletal for you to develop.

COLUMN 4 - TEACHING AND LEARNING ACTIVITIES (T/LA)

Teaching and Learning Activities that will ensure maximum student participation in the lessons are presented in Column 4. Avoid rote learning and drill-oriented methods and rather emphasize participatory teaching and learning in your lessons. Emphasize the cognitive, affective and psychomotor/practical domains of knowledge in your instructional system, wherever appropriate. You are encouraged to re-order the suggested teaching and learning activities and also add to them where necessary in order to achieve optimum student learning. As we have implied already, the major purpose of teaching and learning is to make students able to apply their knowledge in dealing with issues both in and out of school.

COLUMN 5 - EVALUATION

Suggestions and exercises for evaluating the lessons of each unit are indicated in Column 5. Evaluation exercises can be in the form of oral questions, quizzes, assignments, homework, project work, etc. Ask questions and set tasks and assignments etc. that will challenge students to apply their knowledge to issues and problems as already indicated and will assist them in developing solutions and positive attitudes towards the subject.

PROFILE DIMENSIONS

Profile dimensions describe the underlying behaviours or abilities students are expected to acquire as a result of having gone through a period of instruction. Each of the specific objectives in this syllabus contains an action verb that specifies the type of learning or skill that the student should acquire by the end of the instructional period. A specific objective as follows: The student will be able to describe …etc. contains an action verb "describe" that indicates what the student will be able to do after teaching and learning have taken place. Being able to "describe" something after the instruction has been completed means that the student has acquired "knowledge". Being able to explain, summarize, give examples, etc. means that the student has understood the lesson taught. Similarly, being able to develop, plan, construct etc, means that the student has learnt to create, innovate or synthesize knowledge. Each of the action verbs in the specific objectives of the syllabus describes the behaviour the student will be able to demonstrate after the instruction. "Knowledge", "Application", etc. are dimensions that should be the prime focus of teaching, learning and assessment in schools.

Electronics is a practical subject and the learning required is best achieved by practical application of skills learnt. The profile dimensions required in this subject and their respective weights are as follows:

Knowledge and Understanding	20**%**
Application of Knowledge	30**%**
Attitudes and Practical Skills	50**%**

Each of the dimensions has been given a percentage weight that should be reflected in teaching, learning and testing. The weights show the relative emphasis that the teacher should give in the teaching, learning and testing processes. Combining the three dimensions in the teaching and learning process will ensure that electronics is taught and studied not only at the cognitive level, but will also lead to the acquisition of practical skills in the subject.
The explanation of the key words involved in each of the profile dimensions is as follows:

Knowledge and Understanding (KU)

Knowledge — The ability to:
remember, recall, identify, define, describe, list, name, match, state principles, facts and concepts. Knowledge is simply the ability to remember or recall material already learned and constitutes the lowest level of learning.

Understanding — The ability to:
explain, summarize, translate, rewrite, paraphrase, give examples, generalise, estimate or predict consequences based upon a trend. Understanding is generally the ability to grasp the meaning of some material that may be verbal, pictorial, or symbolic.

Application of Knowledge (AK)

Ability to use knowledge or apply knowledge, as implied in this syllabus, has a number of learning/behaviour levels. These levels include application, analysis, innovation or creativity, and evaluation. These may be considered and taught separately, paying attention to reflect each of them equally in your teaching. The dimension "Use of Knowledge" is a summary dimension for all four learning levels. Details of each of the four sub-levels are as follows:

Application	The ability to: apply rules, methods, principles, theories, etc. to concrete situations that are new and unfamiliar. It also involves the ability to produce, solve, operate, demonstrate, discover etc.
Analysis	The ability to: break down materials into its component parts; to differentiate, compare, distinguish, outline, separate, identify significant points etc, recognize unstated assumptions and logical facilities, recognize inferences from facts etc.
Innovation/Creativity	The ability to put parts together to form a new whole. It involves the ability to synthesize, combine, compile, compose, devise, suggest a new idea or possible ways, plan, revise, design, organize, create, and generate new solutions. The ability to create or innovate is the highest form of learning. The world becomes more comfortable because some people, based on their learning, generate new ideas, design and create new things.
Evaluation	The ability to: appraise, compare features of different things and make comments or judgments, contrast, criticize, justify, support, discuss, conclude, make recommendations etc. Evaluation refers to the ability to judge the worth or value of some materials, ideas etc., based on some criteria. Evaluation is a constant decision making activity. We generally compare, appraise and select throughout the day. Every decision we make involves evaluation. Evaluation is a high level ability just as application, analysis and innovation or creativity since it goes beyond simple knowledge acquisition and understanding.

Practical Skills (PS)

Practical skills involve the use of tools/equipment and materials to carry out practical operations. The teaching and assessment of practical skills should involve projects and creative practical tasks.

"Attitudes and Practical Skills" is given 50 per cent of the teaching, learning and testing time to emphasize the point that Applied Electronics at the SHS level should be practically oriented. The remaining 50 percent of knowledge in the subject is distributed to the theoretical aspect involving acquisition of knowledge, understanding and application of knowledge and understanding of theoretical issues/problems.Skills required for effective practical work are the following:

1. Handling Tools/Equipment/Materials
2. Observation
3. Perception
4. Creativity
5. Communication

Tools/Equipment/Materials Handling: Students should be able to handle and use tools/equipment/materials properly for practical work to acquire the needed manual skills.

Observation: The student should be able to use his/her senses to make accurate observation of skills and techniques needed in practical work. The student should be able to imitate the techniques he/she has observed for performing tasks in electronics.

Perception: The student should be able to respond to his/her environment using all the senses i.e. seeing, hearing, smelling, touching and tasting. The student should be encouraged to apply the senses to every project he/she undertakes.

Originality/Creativity Students should be encouraged to be creative or original and be able to use new methods in carrying out projects. They should be encouraged to be original in their practical work and not copy existing work. You can help them to be creative and original by encouraging any little creative effort, technique and product they may develop.

Communication: Students should be guided to develop effective oral and written communication skills necessary for group work, oral and written reports.

The action verbs provided under the various profile dimensions should help you to structure your teaching such as to achieve the set objectives. Select from the action verbs provided for your teaching, in evaluating learning before, during and after the instruction.

FORM OF ASSESSMENT

It is important that both instruction and assessment be based on the profile dimensions of the subject. In developing assessment procedures, select specific objectives in such a way that you will be able to assess a representative sample of the syllabus objectives. Each specific objective in the syllabus is considered a criterion to be achieved by the student. When you develop a test that consists of items based on a representative sample of the specific objectives taught, the test is referred to as a "Criterion-Referenced Test." In many cases, a teacher cannot test all the objectives taught in a term or even a year. The assessment procedure used i.e. class tests, homework, projects and end-of-term tests, must be developed in such a way that it will consists of a sample of the important objectives taught over a period.

The example on the next page shows the recommended end-of-term examination structure for Applied Electricity/Electronics. The structure shows two examination papers. School Based Assessment (SBA) forms part of the end-of-term examination system.

END OF TERM EXAMINATION

The chart below shows the mode of assessment and weighting to be followed by teachers at the end of the term. There will be two papers in the examination: PAPER 1 (Theory) and PAPER 2 (Practical).

Section A of Paper 1 is an objective type section testing knowledge and understanding of Electronics. Section B consists of structured questions testing application of knowledge. Paper 2 will test practical skills in electronics.

END- OF-TERM EXAMINATION STRUCTURE

DIMENSION	PAPER 1 (THEORY)		PAPER 2 (PRACTICALS)	TOTAL MARKS	% WEIGHTING
	A (MC)	B (STRUCTURE)			
Knowledge and Understanding	50	-	-	50	20
Application of Knowledge	-	50	-	50	30
Attitudes and Practical Skills	-	-	100	100	50
Total Marks	50	50	100	**200**	
% Contribution of Exams Papers	40	60	100	-	100

The structure of the examination in the table follows the structure in the WAEC examination presented as follows:

PAPER 1 (THEORY): This consists of two (2) Sections, A and B.

SECTION A - This will consist of fifty (50) multiple choice/objective questions from the syllabus to be answered in one (1) hour for fifty (50) marks.

SECTION B - This will consist of ten (10) short answer questions drawn from the syllabus. Candidates will be required to respond to five (5) questions in one (1) hour for a total of fifty (50) marks.

PAPER 2 (PRACTICALS): This consists of two practical experiments to be carried out in three (3) hours for a total of 100 marks.

GUIDELINES FOR SCHOOL-BASED ASSESSMENT (SBA)

A new School Based Assessment system (SBA) will be introduced into the school system in 2011. The new SBA system is designed to provide schools with an internal assessment system that will help schools to achieve the following purposes:

- Standardize the practice of internal school-based assessment in all Senior High Schools in the country
- Provide reduced assessment tasks for subjects studied at SHS
- Provide teachers with guidelines for constructing assessment items/questions and other assessment tasks
- Introduce standards of achievement in each subject and in each SHS class
- Provide guidance in marking and grading of test items/questions and other assessment tasks
- Introduce a system of moderation that will ensure accuracy and reliability of teachers' marks
- Provide teachers with advice on how to conduct remedial instruction on difficult areas of the syllabus to improve class performance.

The arrangement for SBA may be grouped in categories as follows. Folio Preparation, Project designed to include folio preparation, Mid-Term test, Group Exercise and End of Term Examination.

Folio Preparation**:** Folio preparation may include the following:

i. Specific Design
ii. Investigative study and field visit reports.

Project: This will consist of a selected topic to be carried out by groups of students for a year. Segments of the project will be carried out each term toward the final project completion at the end of the year,

Mid-Term Test: The mid-term test following a prescribed format will form part of the SBA

Group Exercise: This will consist of written assignments or practical work on a topic(s) considered important or complicated in the term's syllabus

End-of-Tem Examination: The end-of-term test is a summative assessment system and should consist of the knowledge and skills students have acquired in the term. The end-of-term test for Term 3 for example, should be composed of items/questions based on the specific objectives studied over the three terms, using a different weighting system such as to reflect the importance of the work done in each term in appropriate proportions. For example, a teacher may build an End-of-Term 3 test in such a way that it would consist of the 20% of the objectives studied in Term 1, 20% of objectives studied in Term 2 and 60% of the objectives studied in Term 3.

GRADING PROCEDURE

To improve assessment and grading and also introduce uniformity in schools, it is recommended that schools adopt the following WASSCE grade structure for assigning grades on students' test results. The WASSCE grading structure is as follows:

Grade A1:	80 - 100%	-	Excellent
Grade B2:	70 - 79%	-	Very Good
Grade B3:	60 - 69%	-	Good
Grade C4:	55 - 59%	-	Credit
Grade C5:	50 - 54%	-	Credit
Grade C6:	45 - 49%	-	Credit
Grade D7:	40 - 44%	-	Pass
Grade D8:	35 - 39%	-	Pass
Grade F9:	34% and below	-	Fail

In assigning grades to students' test results, you are encouraged to apply the above grade boundaries and the descriptors which indicate the meaning of each grade. The grade boundaries i.e., 60-69%, 50-54% etc., are the grade cut-off scores. For instance, the grade cut-off score for B2 grade is 70-79% in the example. When you adopt a fixed cut-off score grading system as in this example, you are using the criterion-referenced grading system. By this system a student must make a specified score to be awarded the requisite grade. This system of grading challenges students to study harder to earn better grades. It is hence a very useful system for grading achievement tests.

Always remember to develop and use a marking scheme for marking your class examination scripts. A marking scheme consists of the points for the best answer you expect for each question, and the marks allocated for each point raised by the student as well as the total marks for the question. For instance, if a question carries 20 marks and you expect 6 points in the best answer, you could allocate 3 marks or part of it (depending upon the quality of the points raised by the student) to each point , hence totaling 18 marks, and then give the remaining 2 marks or part of it for organization of answer. For objective test papers you may develop an answer key to speed up the marking.

SENIOR HIGH SCHOOL – YEAR 1

SECTION 1
INTRODUCTION TO ELECTRONICS
General Objectives: The student will:

1. understand the basic concepts of electronics and electricity.
2. be aware of the key differences between the two sciences.
3. understand the nature of electricity and electronics

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	VALUATION
UNIT 1	The students will be able to:			Class Exercise:
CONCEPTS OF ELECTRONICS AND ELECTRICITY	1.1.1 distinguish between Electricity and Electronics	Electronics and Electricity. Differences and Similarities Electronics – is the study of precisely controlling the flow of electrons. Electricity – is the flow of electrons through a pathway that conducts electricity.	Group students to discuss the differences and similarities of electronics and electricity. Follow up with a class discussion to clarify the meanings. Illustrate with a diagram the flow of electrons.	students to explain electronics and electricity Assignment: students to look out from other sources for more differences and similarities of electronics and electricity.
	1.1.2 outline the key differences and similarities of electronics and electricity.	Electricity controls voltage levels and the flow of electrons. Electronics controls the flow of electrons.	Group students to discuss the differences and similarities of electronics and electricity.	
UNIT 2				
NATURE OF ELECTRICITY	1.2.1 explain the nature of electricity and electronics	Nature of Electricity Production of Static Electricity Production of Current Electricity	Group students to discuss how static electricity is produced	students to describe how static electricity is produced.
	1.2.2 distinguish between conductors, insulators and semi conductors using energy level diagrams	Conductor, Insulator and Semi conductor.	Illustrate how current electricity is produced Stress that electronics and electricity are not the same.	explain how current electricity is produced

SENIOR HIGH SCHOOL - YEAR 1

SECTION 2
HEALTH, SAFETY AND PROTECTION
General Objectives: The student will:

1. apply practical skills, safe use of tools and judicious handling of materials in the workshop.
2. recognise potential health and safety hazards in handling materials and equipment in the workshop.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1	The students will be able to:			Students to:
PROTECTIVE DEVICES	2.1.1 identify and describe various types of protective devices.	Protective Devices - Rewritable fuse - Cartridge fuse - Miniature circuit breaker	Using samples assist students to discuss various types of protective devices and demonstrate their uses.	describe types of protective devices and their applications.
UNIT 2	2.1.2 select suitable protective devices in compliance with sizing criteria.	Selection of Protective Devices. - -	Group students to discuss how to select appropriate and suitable protective devices for any application.	select correctly protective devices to satisfy appropriate sizing requirements.
PRECAUTION	2.2.1 identify common hazards at the workshop	Common Hazards, electric shock, fire accident involving tools and machinery.	Discuss common hazards that occur in electronic workshops. Demonstrate protection against electric shock, fire and accident involving tools and machinery Role play what to do to a victim of electric shock, fire and accident involving tools and machinery.	
UNIT 3				
FIRE SAFETY	2.3.1 identify types of fire extinguishers and explain their, properties and appropriate use.	Types of fire extinguishers: Foam Dry powder Sand Water Wet blanket $C0_2$	Discuss the various types of fire extinguishers, their appropriate usage.	explain types of extinguishers and their appropriate use.

SENIOR HIGH SCHOOL - YEAR 1

SECTION 3
ELECTRON EMISSION AND THERMIONIC DEVICES
General Objectives: The student will:

1. recognise the importance of emission of electrons
2. be aware of the principles underlying the operation of thermionic devices.
3. develop knowledge on the general concept of emitting electrons

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1	The students will be able to:			Students to:
ELECTRON EMISSION	3.1.1 explain methods of emitting electrons and their applications.	Methods of Emitting Electrons. Thermionic emission Secondary emission	Group students to discuss the methods of emitting electrons .	explain methods of emitting electrons and their applications.
	3.1.2 state the functions of the electrodes in thermionic devices.	Field emission Photo emission	**Note:** The discussion should bring out the applications of each method. Discuss the function of each electrode	
	3.1.3 explain the Parameters of the Triode Valve.	Function of Electrodes in the Valves: diode triode tetrode pentode Triode valve parameters: trans conductance, amplification factor, anode slope resistance.	Show and draw the symbols of each valve. With illustrations, derive the triode parameters . Discuss applications of thermionic devices with students.	describe the function of each electrode of thermionic device correctly explain the application of thermionic devices.
UNIT 2				
CATHODE RAY TUBE	3.2.1 explain the function of the electrodes in CRT.	Function of electrodes of CRT.	Discuss the functions of each electrode in a Cathode Ray Tube.	outline the functions of electrodes in the cathode ray tube.

SENIOR HIGH SCHOOL - YEAR 1

SECTION 4
DIRECT CURRENT CIRCUIT THEORY
General Objectives: The student will:

1. appreciate the importance of Ohm's law, and be able to apply it to solve problems involving circuit analysis.
2. understand the use of Kirchhoff's voltage and current laws in the solution of problems involving circuit analyses.
3. recognise various forms and types of resistors as circuit elements, and also as transducers.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1	The students will be able to:			Class work:
RESISTORS AS CIRCUIT ELEMENTS	4.1.1 identify types of resistors 4.1.2 describe types of resistors and their properties.	Types of resistors: - fixed Carbon, metal-film, metal oxide, thick-film, cement - Wire wound. Variable: potentiometer, thermistor, varistor, photo-conductive cell Resistor Colour Code.	Guide students to discuss the various types of fixed resistors Discuss the characteristics of the various variable resistors to make them suitable for transducer applications	students to identify and describe various types of resistors and their application apply forms of variable resistors as transducers correctly.
	4.1.3 select value of resistance of a fixed resistor using the resistor colour codes	Connection of resistors. - Series - Parallel	Discuss how to use the Colour Code Table to determine nominal values of resistance.	correctly determine the nominal value of resistance of a resistor using colour code.
	4.1.4 connect resistors in series, and in parallel.	Rating of resistors.	Demonstrate how to connect resistors in series, and in parallel.	connect resistors in series, and in parallel.
	4.1.5 estimate power rating of a resistor by physical size	Ohm's law. V=IR	Through discussion, show how to rate the power handling capacity of various sizes of resistors by means of their physical size.	differentiate various sizes of resistors and relate them to power handling capacity
	4.1.6 explain Ohm's law and use it in calculations involving the determination of circuit parameters.		Group students to brainstorm to come out with the meaning of Ohm's law and show how to apply it to solve problems in circuit analysis.	apply Ohm"s law correctly, and solve problems on simple circuit analysis.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1 (CONT'D) **RESISTORS AS CIRCUIT ELEMENTS**	The students will be able to: 4.1.7 state Kirchhoff's laws and apply them in circuit analysis.	Kirchhoff's laws: Voltage law Current law	Group students to discuss the Kirchhoff's voltage and current laws, and show how to apply them to solve problems to determine circuit parameters involving closed single and double loop networks	Students to: apply the Kirchhoff's laws correctly, and solve problems involving closed single and double loop networks.
UNIT 2 **RESISTIVITY OF A CONDUCTOR**	4.2.1 explain resistivity of a conductor.	Resistivity.	Through discussions, show how resistivity relates to conductivity of materials	make calculations involving resistivity correctly.
	4.2.2 describe various conductors and insulators.	Conductors and Insulators - copper - aluminium - wool - rubber - pvc - wood - mica - asbestos	Discuss the various types of conductors and insulators and their properties.	identify and describe conductors and insulators as useful materials found in electrical and electronics applications
	4.2.3 solve problems involving resistivity.	Calculation of Resistivity.	Assist students to calculate the resistance and length of conductors, measure resistance, calculate diameter of cross-section and cross-sectional area.	explain temperature coefficient of resistance and also identify useful application of this parameter.
	4.2.4 define temperature coefficient of resistance.	Temperature coefficient of resistance and application.	Through discussions, show how temperature coefficient of resistance is a very useful parameter that finds wide application in measurements and fault diagnosis.	
UNIT 3 **POWER AND ENERGY**	4.3.1 explain the terms power and energy.	Power and Energy.	Discuss the terms, power and energy, and show how to perform calculations on power and energy.	explain the terms power and energy perform simple calculations on power and energy.
	4.3.2 solve problems involving power and energy.	Calculation on Power and Energy.	Assist students to solve problems on power and energy.	

SECTION 5
ELECTRIC FIELD
General Objectives: The student will:

1. be aware of how to select, and apply capacitor correctly in electronic circuits
2. understand how to apply the concept of electric field including its characteristics and properties in electronic circuit designs

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1	The students will be able to:			Students to:
CONCEPT OF ELECTRIC FIELD	5.1.1 explain electric field and its properties	Characteristics of Electric Field. Properties of Electric Field : Electric flux, electric flux density, Electric field strength, permittivity and dielectric constant.	Group students to discuss the characteristics of the electric field. Discuss the properties of electric field and the relationship between the magnetic properties of fields.	describe electric field and its properties, and solve simple problems involving electric field.
UNIT 2				
CAPACITORS	5.2.1 define capacitance of a capacitor.	Capacitance of a capacitor. -	Assist students to deduce the meaning of capacitance of a capacitor, and characteristics under dc conditions	explain capacitance of capacitor, and be able to describe its behaviour under dc conditions correctly
	5.2.2 identify and describe various capacitors and their characteristics.	Types of Capacitor: - air - paper - mica - ceramic - polyester - electrolytic	Show types of capacitors and discuss their characteristics	describe the characteristics of various types of capacitors.
	5.2.3 state the relationship between charge and applied voltage on a capacitor.	Charge on a Capacitor.	Assist students to deduce the relationship between charge and applied voltage of a capacitor and show how to perform simple calculations on them.	explain relationship between charge and applied voltage of a capacitor and solve problems

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 2 (CONT'D) **CAPACITORS**	The students will be able to: 5.2.4 describe the voltage rating of a capacitor.	Capacitor Voltage Rating.	Group students to discuss the importance of selecting the correct voltage rated capacitor for appropriate application	Students to: select the correct voltage rated capacitor for use in various application
	5.2.5 describe application of capacitors.	Application of Capacitors. - Storage of charge; - Blocking dc - Conducting ac - As Timing element	Group students to discuss the applications of a capacitor as charge storage device, as dc blocking device, as ac conducting device, and also as timing element in electronics circuits	explain the function of capacitor in any application, correctly
	5.2.6 solve problems involving capacitors in series and in parallel.	Series And Parallel Connections.	Illustrate how to solve problems involving capacitors in series and in parallel.	solve problems involving capacitors in series and in parallel.
	5.2.7 calculate the energy stored in a capacitor.	Energy stored in a Capacitor $E = ½ cv^2$ Joule.	Discuss how to calculate energy stored in a capacitor, and why it is stored in electrostatic field	solve problems involving energy stored in a capacitor.

SECTION 6
MAGNETIC FIELD
General Objectives: The student will:

1. understand the concept of magnetism.
2. acquire knowledge and skills to apply the principles of magnetization and demagnetization.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1	The students will be able to:			Students to:
FUNDAMENTALS OF MAGNETISM	6.1.1 identify and describe types of magnets and their applications.	Types of magnet: permanent magnet electromagnet	Show types of magnet and discuss their applications with students.	describe types of magnets and their applications correctly.
	6.1.2 describe the properties of magnetic materials.	Magnetic Properties. flux, flux density, permeability, magnetomotive force (mmf), magnetizing force, and reluctance.	Discuss the properties of magnetic materials with students.	describe magnetic properties and perform calculations involving magnetic properties and series circuits.
	6.1.3 solve problems involving simple magnetic circuit.	Calculations on Magnetic Circuits.	Guide students to Solve problems involving magnetic circuits.	
UNIT 2				
B/H CURVE AND HYSTERESIS LOOP	6.2.1 explain magnetization and demagnetization of a magnetic material.	• Magnetic Domains • Magnetization • Demagnetization of magnetic material.	Discuss the concept of magnetic domains, and show how to apply the concept to describe the magnetization and demagnetization of a magnetic material.	apply concept of magnetic domains to describe the magnetization and demagnetization of a magnetic material.
	6.2.2 draw the B/H curve and the hysteresis loop analyse them	B/H curve. Hysteresis loop	Assist students to draw the B/H curve and the hysteresis loop and analyze them.	draw the B/H curve and the hysteriesis loop and analyse them.

SENIOR HIGH SCHOOL - YEAR 2

SECTION 1
ELECTROMAGNETISM
General Objectives: The student will:

1. understand how to apply the concept of electromagnetism in designs.
2. apply the principle of electromagnetic induction correctly.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1	The students will be able to:			Students to:
ELECTRO-MAGNETIC FIELD	1.1.1 draw the magnetic field around a current carrying conductor, and a wound coil.	Current Carrying Conductor.	Group students to discuss magnetic field, and show how to trace the magnetic lines of force around a current carrying conductor, and also those around a wound coil or a solenoid.	trace the magnetic lines of force around a current carrying conductor correctly
	1.1.2 calculate the force on a current carrying conductor in a magnetic field.	Force on Current Carrying Conductor $F = B L I \sin\theta$ Newtons	Assist students to calculate the force on a current carrying conductor in a magnetic field.	calculate the force on a current carrying conductor in a magnetic field.
UNIT 2				
ELECTRO-MAGNETIC INDUCTION	1.2.1 identify and describe Laws of electromagnetic induction.	Laws of Electromagnetic Induction. • Lenz's Law • Faraday's Law	Assist students to deduce Lenz's law and Faraday's Law, and show how to apply them correctly.	explain Lenz's Law and Faraday's Law correctly. determine the direction of induced e.m.f. using Lenz's law.
	1.2.2 calculate the induced e.m.f in a conductor cutting a magnetic field.	Calculation of Induced e.m.f: $e = Blv$ volts.	Perform calculations involving electromagnetic induction with students. **Note:** Emphasise the effects of combined fields on current carrying conductor.	calculate the induced e.m.f. in a conductor cutting a magnetic field.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 3	The students will be able to:			Students to:
SELF AND MUTUAL INDUCTION	1.3.1 describe behaviour of a coil in a dc circuit and calculate the energy stored in it	Energy stored $E = \frac{1}{2} LI^2$ joules. Coils connected in series and in parallel.	Discuss with students how a coil, under dc, stores energy in electromagnetic field, and calculate the energy stored..	calculate the energy stored in a coil correctly.
	1.3.2 describe the application of electromagnetism.	The Application of Electromagnetism: • moving coil instrument, electric bell,light dimmer, solenoid/relay,loud speaker, buzzer, transformer,	Group students to discuss the applications of electromagnetism	explain the various applications of electromagnetism,
	1.3.3 determine differences between self and mutual induction.	Self Induction and Mutual Induction. • Self induction - involves one coil • Mutual - two or more coils	Assist students to brainstorm to come out with the meaning of self and mutual induction.	explain self and mutual induction correctly
	1.3.4 solve problems involving self induction and mutual induction.	Calculation of Self and Mutual Induction.	Discuss clearly that self induction involves one coil, while mutual induction entails two or more coils. Assist students to perform calculations involving self and mutual induction.	solve problems involving self and mutual induction.
	1.3.5 calculate the values of inductor in series and parallel connection.	Calculation of series and parallel connection of inductors	Discuss and bring out how to perform calculations on series/parallel connections of coils.	solve problems on series/ parallel connections of inductors.
	1.3.6 design and wire up simple bell circuit, and security alarm system.	Wiring of Security System.	Assist students to design and wire up a simple door bell circuit, and security alarm system.	design and wire up simple door bell circuit, and security system.
Unit 4				
CONS-TRUCTION OF TRANS-FORMER	1.4.1 identify the types of transformer and their construction.	Types of transformer construction - shell type - core type	Show types of transformer to students and assist them to discuss their construction.	describe types of transformer construction

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 4 (CONT'D)	The students will be able to:			Students to:
CONSTRUCTION OF TRANSFORMER	1.4.2 explain the principle of operation of a transformer	Operation of a transformer	Use charts or models to discuss the principles of a transformer with students.	explain the principles of operation of a transformer
	1.4.3 solve problems involving transformation ratio.	Transformation ratio	Assist students to solve problems involving transformation ratio.	solve problems involving transformation ratio

SECTION 2
MEASUREMENTS AND INSTRUMENTS
General Objectives: The student will:

1. understand and apply the principle of operation of measuring instruments.
2. appreciate the conversion of galvanometer to Ammeter and Voltmeter.
3. acquire skills in the use of measuring instruments.
4. develop skills in the use and care for the digital multimeter for measurement of quantities.
5. develop knowledge and skills in using the CRO for measuring waveform and voltage.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1	The students will be able to:			Students to:
MOVING COIL INSTRUMENT	2.1.1 explain the operation of moving coil instrument	Operation of Moving Coil Instrument.	Guide students to discuss the principles of the operation of moving coil instrument.	explain the operation of moving coil instrument.
	2.1.2 describe the construction of a moving coil instrument.	Construction of a Moving Coil Instrument.	Group students to discuss the construction of a moving coil instrument.	construct moving coil instrument.
	2.1.3 outline the advantages and disadvantages of moving coil instrument.	Advantages and Disadvantages of a Moving Coil Instrument.	Discuss the advantages and disadvantages of a moving coil instrument.	state the advantages and disadvantages of a moving coil instrument.
	2.1.4 convert a moving coil galvanometer to an ammeter, or voltmeter.	Conversion of a Moving Coil Galvanometer Shunts and Multipliers.	Demonstrate how to convert a moving coil galvanometer into an ammeter or a voltmeter using shunts and multipliers.	convert a moving coil galvanometer to an ammeter and voltmeter using multipliers and shunts.
	2.1.5 solve problems involving shunts and multipliers.	Determining Values of Shunts and Multipliers.	Assist students to solve problems involving shunts and multipliers	solve problems involving shunts and multipliers correctly
	2.1.6 use galvanometer to measure resistance.	Measurement of Resistance	Discuss how to use the galvanometer in a Wheatstone Bridge network to measure resistance, and show how to determine/calculate balance conditions.	set up and describe the Wheatstone bridge to measure resistance, and perform simple calculations involving balance conditions

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 2 **MOVING IRON INSTRUMENT**	The students will be able to: 2.2.1 explain the operation of moving iron instrument.	Operation of Moving Iron Instrument.	Assist students to describe the operation of moving iron instrument.	describe the construction and operation of moving iron instrument.
	2.2.2 describe the construction of a moving iron instrument.	Construction of Moving Iron Instrument.	Describe the construction of a moving coil instrument.	describe moving iron instrument.
	2.2.3 outline the advantages and disadvantages of moving iron instrument.	Advantages and Disadvantages of a Moving Iron Instrument.	Students discuss in groups the advantages and disadvantages of a moving iron instrument.	state the advantages and disadvantages of moving iron instrument.
UNIT 3 **DIGITAL MULTIMETER**	2.3.1 use multimeter to measure Electrical quantities.	Measurement of Electrical Quantities • Voltage • Current • Resistance	Demonstrate the use of digital multimeter to measure electrical quantities. Discuss the use and care of digital multimeter.	use digital multimeter to measure electrical quantities.
UNIT 4 **CATHODE RAY OSCILLOSCOPE (CRO)**	2.4.1 describe the application of cathode ray oscilloscope.	Application of CRO	Brainstorm to bring out the various applications of cathode ray oscilloscope in measurement.	describe the application of cathode ray oscilloscope correctly.
	2.4.2 explain the functions of the controls on CRO.	Functions of Controls of CRO	Group students to discuss the functions of the controls on CRO.	draw the block diagram of cathode ray oscilloscope and explain the functions of the blocks.
	2.4.3 draw a block diagram of cathode ray oscilloscope (CRO) and explain the function of the blocks.	Cathode Ray Oscilloscope.	Assist students to draw the block diagram of cathode ray oscilloscope and discuss the function of each block.	
	2.4.4 use CRO to observe waveform and measure voltage.	Measurement of Voltage Quantities Using CRO.	Demonstrate how to calibrate and use CRO to measure voltage and observe wave forms.	

SECTION 3
ALTERNATING CURRENT CIRCUIT THEORY
General Objectives: The student will:

1. understand the concept of alternating current generation.
2. understand the effect of resistance, inductance and capacitance in a.c. circuit.
3. be aware of the effect of frequency on discrete components in a circuit.
4. acquire knowledge and skills for solving problems connected with alternating current generation

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1	The students will be able to:			Students to:
GENERATOR PRINCIPLE	3.1.1 identify the component parts of a.c. generator, and describe the functions of the parts..	Parts of a generator. - Stator - Rotor	Using a real generator, show the parts of a generator and discuss their functions with students	mention parts of a generator and describe the function.
	3.1.2 explain the principles of operation of a generator.	Principle of operation of a Generator.	Group students to discuss the principles of operation of a generator.	explain the principle of operation of generator.
	3.1.3 explain the various a.c. quantities	A.C. Quantities RMS Value, Peak Value, Peak –Peak, Average value, Waveform factor, Cycle, Period and Frequency.	Assist students to discuss the various a.c. quantities and perform simple calculations.	define a.c. quantities and solve problems
UNIT 2				
RLC CIRCUIT	3.2.1 explain the purpose of a filter in a.c. circuit.	Purpose of Filler In ac Circuit - Active Filters. - Passive Filters	Assist students to identify Active and passive Filters and explain their purpose in ac circuit. Assist them to draw circuit diagrams and general symbols of Low pass, High pass, Band pass and Band Stop filters	draw circuit diagrams and general symbols of Low pass, High pass, Band pass and Band Stop filters
	3.2.2 solve problems involving RL series circuit.	Solution of Problems of RL Series Circuit.	Assist students to solve problems involving RL series circuit.	solve problems involving RL series circuit.
	3.2.3 draw phasor diagram for RL Series circuit.	Phasor Diagram for RL Circuit.	Assist students to draw a phasor diagram for RL series circuit.	draw a phasor diagram for RL series circuit.
	3.2.4 solve problems involving RC series circuit.	Solution of Problems Involving RC Series Circuit.	Group students to solve problems involving RC series circuit.	solve problems involving RC series circuit.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 2 (CONT'D)	The students will be able to:			Students to:
RLC CIRCUIT	3.2.5 draw phasor diagram for RC series circuit.	Phasor Diagram for RC Series Circuit.	Assist students to draw a phasor diagram for RC series circuit.	draw a phasor diagram for RC in series circuit.
	3.2.6 explain the characteristics of RLC circuit and solve problems involving RLC series circuit	RLC Series Circuit. • XL = 2TIfL • XC = ½ fc • $Z = R2 + X^2$	Group students to discuss the characteristics of RLC circuit and solve problems involving RLC series circuit.	solve problems involving RLC series circuit.
	3.2.7 draw phasor diagram for RLC series circuit.	Phasor Diagram for RLC Series Circuit.	Using illustrations assist students to draw a phasor diagram for RLC series circuit.	draw a phasor diagram for RLC series circuit.
	3.2.8 describe the conditions at which resonance occurs.	Conditions for occurrence of Series Resonance.	Discuss resonance and the conditions at which resonance occurs.	describe the conditions at which resonance occurs correctly.
	3.2.9 draw phasor diagram of a series resonance circuit.	Phasor Diagram for Series Resonance.	Assist students to draw phasor diagram of a series resonance circuit.	draw phasor diagram of a series resonance circuit.

SECTION 4
SEMICONDUCTOR DIODES
General Objectives: The student will:

1. understand correctly the formation and applications of P-N junction
2. recognise differences between n-type and p-type materials.
3. acquire knowledge of the construction of semiconductor devices.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1	The students will be able to:			Students to:
SEMI CONDUCTOR THEORY	4.1.1 describe the electrical properties of semiconductor materials.	Electrical Properties of Semiconductor Materials: • Silicon and Germanium	Discuss the electrical properties of semiconductor materials Show the formation, of p-type and n- type materials.	explain the properties of semi conductor materials and the formation of p-type and n-type semiconductor materials correctly.
	4.1.2 describe formation of p-type and n- type semiconductor materials and explain their importance.	Doping.	Brainstorm to come out with the importance of doping to obtain p-type and n-type materials.	
	4.1.3 differentiate between n-type and p-type semi conductor materials.	Differences between n-type and p-type Semi Conductor Materials.	Assist students to discuss the difference between the two types of materials.	explain doping and the difference between n-type and p-type materials.
UNIT 2				
DIODE	4.2.1 explain the formation of P-N junction diode.	Formation of P-N Junction Diode.	Group students to discuss and show how the P-N junction diode is formed.	describe P-N junction diode formation correctly.
	4.2.2 analyze the difference between forward and reverse biasing with reference to P-N junction diode.	Forward and Reverse Biasing.	Through discussions, show how to forward and reverse bias the P-N junction.	analyze the difference between forward and reverse biasing of P-N junction diode correctly.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 2 (CONT'D.)	The students will be able to:			Students to:
DIODE	4.2.3 draw the v/I characteristic of a P-N junction diode.	Characteristics of P-N Junction Diode.	Discuss the characteristics of the P-N junction.	connect P-N junction diode in a circuit, and determine the V/I characteristics of the diode.
	4.2.4 describe the application of P-N junction diode.	Application of P-N Junction Diode.	Using a chart, assist students to draw the V/I characteristics of a diode, set up a suitable circuit, take measurements, analyse and draw conclusions.	describe the application of a diode.
UNIT 3				
ZENER DIODE AND LED	4.3.1 explain the formation of Zener diode and LED.	Formation of Zener diode and LED	Discuss the application of the P-N junction diode.	describe the formation of Zener diode and LED correctly.
	4.3.2 draw the v/I characteristic of a Zener diode.	Characteristics of P-N Junction Diode.	Using a chart, show how Zener and LED are formed.	connect Zener diode in a circuit, and determine the V/I characteristics of the diode.
			Using charts, discuss the characteristics of the Zener diode.	compare Zener diode to P-N junction and state the differences.

SECTION 5
D.C. POWER SUPPLY
General Objectives: The student will:

1. understand and apply principles of rectification and regulation.
2. understand the operation of switch mode power supply (SMPS)
3. develop knowledge and skills in applying design principles of d.c. power supply.
4. draw and interpret block diagram and circuit layout of schematics diagrams.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1	The students will be able to:			Students to:
DC POWER SUPPLY UNIT	5.1.1 describe the function of each block element in dc power supply unit and draw a simple dc power supply circuit	Function of Block Elements of Power Supply Unit. DC power supply circuit	Assist students to construct a d.c. power supply and perform simple calculations	describe the function of each block in the power supply unit and solve simple problems involved.
	5.1.2 identify voltage level of a given d.c. source.	Power Supply Unit Dry cell Solar cell Cadium cell Accumulator	Group students to discuss the various power supply sources, their voltage levels and suitability as d.c. sources Illustrate with a block diagram the d.c power supply unit.	identify voltage levels for d.c sources.
	5.1.3 draw a block diagram of a.c to d.c power supply.	Block Diagram of Power Supply.	Assist students to discuss the function of each block of the power supply unit.	draw block and waveform diagram at each stage of the d.c. power supply unit and interpret the drawing.
UNIT 2				
RECTI-FICATION	5.2.1 connect half and full wave rectifier circuit.	Types of Rectification: - full wave bridge - full wave centre tapped - half wave	Demonstrate how to connect half-wave and full-wave rectifier circuits.	use a d.c power supply to connect various types of rectifier circuit and measure the output voltage, solve simple problems on rectification correctly.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 3	The students will be able to:			Students to:
VOLTAGE REGULATION AND STABI-LIZATION	5.3.1 explain voltage regulation and stabilisation circuit.	Voltage Regulator.	Group students to design, draw and construct a simple voltage regulator circuit, and perform simple calculations on the circuit design.	connect a simple regulator circuit and perform simple calculations.
	5.3.2 perform simple calculation on voltage regulation.	Simple Calculations.	Group students to discuss the ways of conducting measurements and perform simple calculations.	measure voltage at various points. also solve simple problems correctly.
UNIT 4				
REGULATED POWER SUPPLY	5.4.1 describe the operation of switch mode power supply (SMPS) and state its advantages and disadvantage.	Switch Mode Power Supply.	Using a block diagram, group students to discuss the operation of switch mode power supply (SMPS).	draw a block diagram of switch mode power supply (SMPS). And explain its operation.
	5.4.2 draw the block and the waveform diagram at each stage of the unit	Application And Advantages of SMPS.	Group students to discuss the application and advantages of switch mode power supply (SMPS).	state the advantages and disadvantages of SMPS.
	5.4.3 draw the diagram of switch mode power supply (SMPS).	Compare the SMPS to the DC power supply.	Using models group students to discuss the block diagram of SMPS and DC Power Supply.	draw the block diagram of the switch mode power supply (SMPS) and the DC Power Supply.

SECTION 6
BIPOLAR, UNIPOLAR TRANSISTOR AND OTHER SEMICONDUCTORS DEVICES
General Objectives: The student will:

1. recognise the difference between Bipolar and Unipolar transistors.
2. develop knowledge in the formation and fabrication of transistors.
3. develop knowledge and skills in the modes of connection of transistor and other semiconductor devices.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1	The students will be able to:			Students to:
TRANSISTOR (BIPOLAR)	6.1.1 explain the principles of operation of the three configurations of bipolar Transistor.	Principles of Operation.	Discuss the principles of operation of each of the three configurations to implement circuit ideas with students.	explain the operation of the three configurations.
	6.1.2 describe the principles of transistor action and explain the biasing of NPN and PNP transistors.	Transistor Action of the two P-N Junction Devices (NPN and PNP).	Group students to discuss the principles of transistor action and biasing of NPN and PNP transistors.	describe transistor action and explain biasing of NPN and PNP transistors.
	6.1.3 draw configurations of a NPN bipolar transistor.	Configurations of a NPN Bipolar Transistor. (mode of connection)	Assist students to discuss and draw the three configurations of a NPN bipolar transistor CC, CB, CE and assist students to practise .	sketch the three configurations of a bipolar transistor and explain the advantages of each.
	6.1.4 connect the three Configurations of a transistor in circuits.	Circuit Connection.	Group students to connect the three configurations of a transistor in circuits.	connect each configuration of a transistor and explain action in the circuit. .
	6.1.5 sketch the characteristic curves of NPN bipolar transistor.	Characteristics of NPN Transistor.	Sketch the characteristic curves of NPN bipolar transistor.	sketch the characteristic curves of bipolar transistor and to interpret them by indicating saturation, active and cut off regions correctly.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 2	The students will be able to:			Students to:
UNIPOLAR TRANSISTOR	6.2.1 identify and draw circuit symbol of JFET.	P- Channel and N- Channel of Field Effect Transistor (JFET).	Assist students to draw circuit symbols of JFET, P and N channel devices.	Draw the circuit symbol of JFET.
	6.2.2 explain the principle of operation of JFET.	Principles of operation of N-Channel JFET.	Discuss the principle of operation of JFET configuration.	Explain the operation of the JFET configuration.
UNIT 3				
OTHER SEMI CONDUCTOR DEVICES	6.3.1 identify semiconductor devices on an electronic circuit	Semi Conductor Devices: - diac - triac - silicon controlled Rectifier (SCR)	Discuss to show how to identify and draw the symbols of various semiconductor devices listed and explain their characteristics.	draw the symbols for semiconductor devices and explain characteristics.
	6.3.2 draw semiconductor symbols. 6.3.3 test and describe application of semiconductor devices.	Application of Semi-Conductor devices: - diac - triac - silicon controlled Rectifier - (SCR) - LE LED - Zener diode	Group students and assist them to test semiconductor devices and demonstrate their application.	apply and test semiconductor devices connected in circuits.
	6.3.4 apply the photo transistors.	Photo Transistor Application. Photo Transistor.	Discuss the principle of operation of photo transistor and show how p-n junction gives rise to the effect. In groups students should discuss and bring out how to apply photo transistor.	explain the operation of photo transistor.
	6.3.5 design and construct a burglar alarm using photo transistors.	Construction of Burglar Alarm.	Assist students to design and construct a burglar alarm circuit using photo transistors.	Home work: design and construct a burglar alarm circuit using photo transistors.
Unit 4				
INTEGRATED CIRCUIT	6.4.1 identify ordinary integrated Circuit.	Integrated Circuits.	Assist students to use integrated circuits.	identify simple integrated circuit components.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 4 (CONT'D.)	The students will be able to:			Students to:
INTEGRATED CIRCUIT	6.4.1 explain the scales of integration.	Scales of integration- small scale (SSI), medium scale (MSI), large scale (LSI) and very large scale integration (VLSI)	Use illustrations to show the number of circuits per chip and explain the scales of integration	explain the scales of integration.
	6.4.2 use integrated circuits .	Passive components-resistor, capacitor and inductor. Active components-Bipolar junction transistors, JFETs	Show active and passive components of integrated circuits to students.	discuss the number of circuits per chip.
	6.4.3 state the advantages and disadvantages of IC	Advantages and disadvantages of ordinary integrated Circuit.	Group students to discuss the advantages and disadvantages of ordinary integrated Circuit	state the advantages and disadvantages of ordinary integrated Circuit

SECTION 7
AMPLIFIERS

General Objectives: The student will:

1. develop knowledge in the operation and application of voltage amplifiers.
2. apply the skills of using electrical and electronics active component as amplifiers.
3. develop knowledge in the methods of biasing amplifiers.
4. investigate the characteristics of operational amplifiers.
5. construct and test amplifiers.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1	The students will be able to:			Students to:
VOLTAGE AMPLIFIERS	7.1.1 explain methods of biasing transistor amplifiers to fix quiescent point.	Biasing Methods. • Common emitter biasing	Group students to discuss the reasons for selecting biasing method used to fix quiescent point.	explain methods of biasing transistor amplifiers.
	7.1.2 draw the output characteristics of common emitter transistor.	Output Characteristics of Common Emitter Transistor.	Assist students to draw the output characteristics of a common emitter amplifier.	draw the output characteristics of a common emitter transistor amplifier with a load line, and solve simple problems involving load line, collector voltage and quiescent point.
	7.1.3 draw a single stage common emitter amplifier.	Single Stage Common Emitter Amplifier.	Assist students to draw a single stage common emitter amplifier and perform simple calculations on it.	draw single stage common emitter amplifier and solve simple problems on CE amplifier.
	7.1.4 outline advantages and disadvantages of negative feedback.	Negative Feedback.	Brainstorm to come out with the advantages and disadvantages of negative feedback.	outline the advantages and disadvantages of negative feedback.
	7.1.5 calculate the voltage gain of a transistor amplifier.	Gain of an Amplifier.	Assist students to calculate voltage gain of a transistor amplifier	calculate the voltage gain of an amplifier and solve simple transistor problems correctly.
	7.1.6 sketch the gain, and frequency response of an amplifier.	Gain and Frequency Response of an Amplifier.	sketch the gain and frequency response of a common emitter amplifier.	sketch the gain, and frequency response of a transistor amplifier.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 2	The students will be able to:			Students to:
POWER AMPLIFIERS	7.2.1 explain methods of biasing and temperature stability of transistor power amplifiers.	Biasing of Power Amplifiers. Class A,B,C and AB	Group students to discuss types of class of power amplifiers.	classify power amplifier.
	7.2. 2 explain the application of an amplifier.	Application of Amplifier.	Group students to discuss applications of a power amplifier.	Explain the applications of an amplifier.
	7.2. 3 calculate power gain.	Calculation of Power Gain.	Demonstrate the various methods of biasing, and temperature stability of power amplifiers. Assist students to calculate the power gain.	analyze the methods of biasing, and temperature stability of power amplifier. calculate power gain and solve simple problems.
UNIT 3				
PUSH PULL AMPLIFIER	7.3.1 identify types of push pull Amplifier and draw a diagram.	Types of Push-Pull Amplifier: • Transformer Coupled • Matched Pair • Complementary Pair Circuit Diagram of Push Pull Amplifier.	Show types of push-pull amplifiers to students . Discuss and draw a diagram of push-pull amplifier.	
	7.3.2 explain the principles of operation of push -pull amplifier.	Principles of operation of Push - Pull Amplifier.	Group students to discuss the principles of operation of the push-pull amplifier.	explain the principles of operation of a push-pull amplifier circuit diagrams.
UNIT 4				
OPERATIONAL AMPLIFIERS	7.4.1 outline the main properties of ideal operational amplifier.	Properties of an Ideal Operational amplifier.	Group students to brainstorm to come out with the main properties of ideal operational amplifiers.	describe the main properties of ideal operational amplifier
	7.4.2 draw inverting and non - inverting operational Amplifier and establish voltage gain for each configuration.	Inverting and Non- Inverting Operational Amplifier.	Assist students to draw inverting and non-inverting operational amplifier circuits. Using illustrations derive the output expressions of the OP - Amp modes of operation and be able to solve simple problems involving operational amplifier.	draw inverting and non-inverting operational amplifier circuits and perform simple calculations on them. solve problems on OP -Amp correctly.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 4 **(CONT'D).** **OPERATIONAL AMPLIFIERS**	The students will be able to: 7.4.3 identify types of operational amplifier.	<u>Types of Operational Amplifier</u> - Summer adder - Integrator - Differentiator - Voltage follower - Diagrams of operational amplifier	Group students to discuss the functions of each type.	state types of OP - Amps
	7.4.4 explain the application of OP-Amp.	Application of Operational Amplifier.	Assist them to discuss the application of the operational amplifier.	Describe application of operational amplifier.

SENIOR HIGH SCHOOL - YEAR 3

SECTION 1
DIGITAL ELECTRONICS

General Objectives: The student will:

1. understand and apply binary numbers and their various conversions with other number systems.
2. understand the function of logic gates and relationship with Boolean expressions
3. understand the principles and operations of sequential logic gates
4. acquire knowledge in the principles and operations of combinational logic gates.
5. apply the functions of the logic
6. develop skills in constructing and testing both combinational and sequential logic gates.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1	The students will be able to:			Students to:
BINARY NUMBERS	1.1.1 convert decimal number to binary number and vice versa.	Conversion of Decimal Numbers to Binary Numbers using Basic Calculations.	Assist students to perform basic calculations on base 2 and 10.	convert correctly, decimal to binary and vice versa.
	1.1.2 convert binary to BCD and Hexadecimal, and vice versa.	Binary Coded Decimal and Hexadecimal Conversions.	Using charts , show how to convert decimal numbers to binary numbers and vice versa, and perform basic calculations including Additions, Subtractions, and fractions Using charts show how to convert binary or decimal into BCD; Hex, and vice versa.	explain correctly the conversions into BCD, Hex, and vice versa in applications.
UNIT 2				
LOGIC GATES	1.2.1 draw general symbols for AND, OR, NOT, NAND, NOR Gates	General Symbols AND, OR, NOT, NAND, NOR Gates.	Illustrate logic symbols for AND, OR, NOT, NAND, NOR Gates	draw general symbols for AND, OR, NOT Gates and explain the function of each gate correctly.
	1.2.2 analyse the function and draw the Truth Table for each gate and write Boolean expression from the Truth Table and implement.	. Truth Table. Boolean Expression.	Assist students to draw Truth Table and with a Boolean expression from a Truth Table..	write Boolean expression from a truth table.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 2	The students will be able to:			Students to:
LOGIC GATES	1.2.3 Draw the timing diagram for the AND, OR, and NOT gates	Series Connection (AND) Gate Parallel Connection (OR) Gate. Inverter (NOT) Gate.	Demonstrate how to connect switches to simulate logic gates: AND, OR, NOT functions	connect switches to simulate AND, OR, NOT logic gate functions.
		Timing Diagram.	Deduce a timing diagram from the Truth Tables, using dynamic input waveforms.	produce timing diagrams correctly, derive from the Truth Table for AND, OR and NOT gates.
UNIT 3				
COMBI-NATIONAL LOGIC GATES	1.3.1 implement an exclusive OR gate from the basic gates.	Exclusive OR Gate	Demonstrate how to implement exclusive OR gate by combination of gates and draw the truth table.	correctly implement exclusive OR gates.
	1.3.2 construct an exclusive NOR gate from universal gates.	Exclusive NOR Gate.	Assist students to construct exclusive NOR gate and draw truth table by combination of gates	construct exclusive NOR gate from universal gates.
UNIT 4				
SEQUENCIAL LOGIC GATES	1.4.1 describe application of the sequential logic gates.	Types of Sequential Gates, Clocked RS	Demonstrate how to use sequential gates and draw theTruth Table.	apply sequential gates to form useful circuits.
	1.4.2 combine bistables to form counters and registers.	Application of Sequential Gates. Counters and Registers.	Discuss how to combine bistables to form counters and registers.	combine bistables to form counters and registers.

SECTION 2
OSCILLATORS
General objectives: The student will:

1. recognise typical oscillator waveforms.
2. develop the principle and operation of oscillators.
3. acquire knowledge and skills in constructing and testing oscillators.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1	The students will be able to:			Students to
OSCILLATORS	2.1.1 identify and describe types of oscillators and their differences	Types of oscillators: - Hartley - Colpitt - Phase shift - Tuned load - Crystal	Discuss types of oscillators and the differences among them.	describe types of oscillators and explain their operation correctly.
	2.1.2 explain the principles of operation of oscillators.	Principles of Operation of oscillators.	Group students to discuss the principles of operation of oscillators.	explain how an amplifier can be made to oscillate.
	2.1.3 explain the operations of tuned load and phase shift oscillator.	Operation of Tuned Load and phase shift Oscillators.	Assist students to discuss tuned load and phase shift oscillators.	explain tuned oscillator operation correctly. .
	2.1.4 Use Oscillators .	Using Oscillators.	Demonstrate how to construct and perform waveform measurements on oscillators. Demonstrate the use of oscillators.	

SENIOR HIGH SCHOOL - YEAR 3

SECTION 3
MULTIVIBRATORS
General objectives: The student will:

1. understand the principles of operation of non-sinusoidal oscillators.
2. recognise typical non-sinusoidal oscillator waveforms.
3. acquire skills in constructing and testing non-sinusoidal oscillators.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1	The students will be able to:			Students to:
NON-SINUSOIDAL OSCILLATORS	3.1.1 identify application of multivibrators.	Application of Multivibrators.	Use charts to discuss applications of multivibrators with students.	identify the applications of each multivibrator correctly
	3.1.2 describe types of non-sinusoidal oscillators.	Types of Non-Sinusoidal Oscillators: Monostable Astable Bistable	Display types of non-sinusoidal oscillators and group students to discuss.	identify types of non-sinusoidal oscillators.
	3.1.3 draw circuit diagram of monostable, astable and bistable multivibrators.	Circuit Diagrams of Non-Sinusoidal oscillators.	Draw circuit diagrams of non-sinusoidal oscillators and discuss with students.	draw and explain circuit diagrams of multivibrators correctly.
	3.1.4 sketch the output waveforms of the multivibrators .	Output Waveform of Multivibrators.	Assist students to sketch the output waveforms of the multivibrators.	sketch the output waveform of bistable oscillators. .
	3.1.5 design and construct multivibrators circuits.	Construction of Multivibrators.	Assist students to design and construct multivibrator circuits.	construct basic multivibrator circuits.

SECTION 4
COMMUNICATION

General Objectives: The student will:

1. understand wave motion and the dependence of communication on it.
2. understand the basic principle of modulation and draw waveforms.
3. understand the principles of operation of both the f.m. transmitter and receiver block diagrams
4. acquire knowledge in the principles of operation of both the a.m. transmitter and receiver block diagrams.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1	The students will be able to:			Students to:
ELECTRO-MAGNETIC WAVES	4.1.1 explain the relationship between velocity, frequency and wave-length.	Characteristics of Radio Waves	Group students to discuss the idea of radio waves as electromagnetic waves to bring out the relationship between velocity, frequency and wavelength.	explain the relationship between velocity, frequency and wavelength.
	4.1.2 solve problems involving electromagnetic waves	Problems of Electromagnetic Waves	Assist students to solve problems involving Electromagnetic waves.	solve problems involving velocity, frequency and wavelength .
UNIT 2				
MODULATION AND DEMODELATION	4.2.1 describe the advantages of FM over AM	Advantages of FM over AM.	Group students to discuss the advantages of FM over AM.	describe advantages of FM over AM.
	4.2.2 sketch carrier and modulated waveforms and explain amplitude modulation.	Amplitude Modulation.	Using charts, assist students to sketch carrier and modulated waveforms and explain amplitude modulation.	sketch and explain amplitude modulation correctly.
	4.2.3 sketch carrier and modulated waveforms and explain frequency modulation.	Frequency Modulation	Use illustrations to assist students to sketch carrier and modulated waveforms and discuss frequency modulation	sketch and explain frequency modulation waveforms correctly.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 3	The students will be able to:			Students to:
TRANSMITTERS AND RECEIVERS	4.3.1 draw block diagram of various stages of super heterodyne radio receiver AM and FM, and describe the function of each block	Superheterodyne Radio Receiver AM, FM. and block diagrams.	Illustrate block diagrams of the various stages of AM and FM superheterodyne receivers and describe the function of each block	draw block diagram of FM superheterodlyne receiver, and describe the function of each block .
	4.3.2 identify the blocks of a colour T.V receiver block diagram and explain the function of each block.	Colour T.V Receiver.	Illustrate the block diagram of colour T.V receiver, and discuss the function of each block.	Homework: draw the block diagram of a colour T.V receiver and describe the function of each block.
	4.3.3 describe and explain the method of communication.	<u>Methods of communication</u> Satellite Fibre optics Microwave Digital communication network Cell phone	Group students to discuss the methods of communication and their differences.	describe some of the different methods of communication
	4.3.4 draw block diagram of AM and FM transmitters and describe the function of each block.	AM and FM Transmitters.	Illustrate block diagrams of AM and FM transmitters and discuss the function of each block.	draw a block diagram of FM transmitter and describe the function of each block
UNIT 4				
TRANSDUCERS	4.4.1 describe types of transducers used for communication.	<u>Types of transducers</u> Microphone Loud speaker Antenna	Assist students to identify and discuss the characteristics of each type of transducer used in communication systems.	describe the characteristics of each type of transducer used in communication system.

SECTION 5
CONTROL SYSTEMS
General objectives: The student will:

1. understand the use of block diagrams to depict real control system.
2. apply the principles in control system.

UNIT	SPECIFIC OBJECTIVES	CONTENT	TEACHING AND LEARNING ACTIVITIES	EVALUATION
UNIT 1	The students will be able to:			
CONTROL SYSTEMS	5.1.1 describe types of control systems.	Open Loop, Closed Loop.	Assist students to brainstorm and come out with the characteristics of control systems using block diagrams representation.	Describe open and closed loop control system correctly
UNIT 2				
PRINCIPLES OF OPERATION	5.2.1 draw the block diagram of open loop and closed loop control systems	Block Diagrams of Open Loop, closed loop.	Group students to draw the block diagram of the open and closed loop control systems and discuss their functions.	Draw and explain the functions of the blocks.

EQUIPMENT AND TOOLS LIST FOR ELECTRONICS

A

NO.	MEASURING INSTRUMENTS
1	Digital Multimeter
2	Analogue Multimeter
3	Digital Insulation Resistance Tester (Megger)
4	Digital Clamp-on-meter
5	Capacitance meter (tester)
6	Inductance meter (tester)
7	Dual trace oscilloscope
8	Transistor tester or semiconductor tester
9	IC test clip
10	Ammeter
11	Voltmeter
12	Wattmeter

B

NO.	EQUIPMENT/COMPONENTS
1	Audio signal Generators or Functional Generators
2	RF Modulated Signal Generator
3	Audio Signal Tracer
4	Patten Generator (Colour)
5	Voltage Stabilizers (UPS)
6	Universal PLC interface
7	Microprocessor training kit
8	Degausing coil
9	Power Supply Unit (Variac Variable DC Power Supply Unit (0-50V)
10	Signal Injector Probe
11	Logic probes
12	Digital electronics Training Kit or System
13	VDD Player
14	Satellite Dish and Decoder Unit
15	Radio Receiver (AM/FM)
16	TV Receiver Black and White/Colour
17	Rheostat
21	Wire wound resistor (Assorted Values)
22	Resistor (Assorted Values)
23	Capacitors (Assorted Values)
24	Inductors (Assorted Values)
25	Single Phase Transformer

C

NO.	CONSUMABLES
1	Electronic components (Active)
2	Flexible cable (telephone)
3	13A socket outlet

D

NO.	TOOLS
1	Set of screw drivers (star) (electronic)
2	Set of screw drivers (flat) (electronic)
3	Pair of pliers (electronic)
4	Pair of side cutters (electronic)
5	Set of spanners(electronic)
6	P.C board (Vero Board)
7	Knife
8	Long Nose Pliers (electronic)
9	Quick Test Board

BIBLIOGRAPHY - ELECTRONICS

1. Experiments in Amplifiers, filters, oscillators and generators by MORRIS TISCHLER
   Publisher M.C. Graw-Hill Book Company

2. Experiments in Telecommunications by MORRIS TISCHLER
   Publisher M.C. Graw-Hill Book Company

3. Feedback and control systems, Latest Edition by J.J. Williams
   Publisher M.C. Graw-Hill Inc.

4. Electricity and Electronics Fundamentals by Paul B. Zbar
   Publisher M.C. Graw-Hill Book Company

5. Colour and mom TV course volumes I, II and III by Borhlham
   Publishers Dickson Publishers

6. Electronics Servicing Volumes I, II and III by Bohlham

7. Radio Servicing Volumes I, II and III by Bohlham

8. Practical Digital Electronics by Hewlett Pachard

9. Basic Television Theory and Servicing by Paul B. Zbar and Peter W. Orne

10. Digital Electronics by Taknein

11. Success in Electronics by Tom Duncan00