NATIONAL BOARD FOR TECHNICAL EDUCATION

CURRICULUM AND COURSE SPECIFICATIONS

NATIONAL DIPLOMA (ND)

IN

ELECTRICAL AND ELECTRONICS ENGINEERING TECHNOLOGY

NOVEMBER, 2024

PLOT B, BIDA ROAD, P.M.B. 2239 KADUNA – NIGERIA
www.nbte.gov.ng

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FOREWORD

This curriculum has been strategically updated to provide skills and knowledge in the field of Electrical and Electronic Engineering Technology. It is designed to prepare technicians to contribute effectively to the diverse and critical industries that rely on electrical and electronic systems across Nigeria.

The curriculum is structured to introduce students to the core principles, theories, and practical applications within electrical and electronic systems, laying a solid groundwork for further specialization and career development. It provides the technicians with the skills to support the design, installation, operation, and maintenance of various electrical and electronic systems and devices.

I would like to express my sincere appreciation to the ERYK Group, industry professionals, and stakeholders whose valuable contributions and unwavering commitment were instrumental in the comprehensive review and updating of this vital curriculum. Their collective expertise ensures the relevance and contemporary applicability of this programme.

It is my hope that the effective implementation of this National Diploma curriculum will create a robust pipeline of skilled technicians who will be instrumental in the development and maintenance of critical electrical and electronic infrastructure across Nigeria, significantly contributing to industrial growth, technological advancement, and national development.

Prof. Idris M. Bugaje
EXECUTIVE SECRETARY
NBTE, KADUNA

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GENERAL INFORMATION

1.0 TITLE OF THE PROGRAMME – National Diploma (ND) in Electrical and Electronics Engineering Technology

2.0 GOAL AND OBJECTIVES OF THE PROGRAMME:

2.1 GOAL: The programme is designed to produce skilled electrical and electronics engineering technicians for manufacturing, assembling, servicing, power generation, transmission, distribution and utilization, telecommunications and other related industries.

2.2 OBJECTIVES:

At the end of the programme the technician should be able to:

1. Solve a range of engineering problems using appropriate mathematical and scientific principles.
2. Support the construction of simple electrical and electronic circuits when necessary for use in modification or as a part of a system
3. Assist in carrying out both preventive and corrective maintenance on simple electrical and electronic installations, equipment and appliances
4. Select and use appropriate instruments to carry out simple tests and measurement on all types of electrical and electronic installation and equipment under various operating conditions.
5. Coordinate and supervise craftsmen in activities related to electrical and electronic engineering services
6. Set up and manage a Small or Medium Scale enterprises or Business
7. Assist in producing technical drawings using appropriate conventions and techniques in engineering workshop settings
8. Adhere to workshop safety practices
9. Operate basic electrical/electronic tools and equipment
10. Apply logical reasoning and problem-solving methodologies to address engineering challenges.
11. Conduct research in electrical and electronics engineering technology using appropriate research methods
12. Draw and interpret electrical and electronics engineering drawings and schematics.
13. Analyse electric current flow, energy relationships, and behaviour in resistive and capacitive systems

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14. Apply differentiation and integration techniques to model and solve engineering problems with the use of simulation software e.g. MATLAB
15. Assist in implementing the principles of generation, transmission, and distribution of electrical energy with hands on practicals and industrial visits to relevant sites.
16. Operate, maintain, and troubleshoot various electrical machines.
17. Apply Alternating Current (AC) theory to analyse and sketch circuits.
18. Assist in performing network analyses of multiphase systems using electrical circuit theorems.
19. Analyse power systems and implement basic operational procedures.
20. Conduct laboratory and industrial measurements using electrical/electronic instruments
21. Implement basic telecommunication techniques and configure communication systems
22. Assist in the installation of electrical systems in buildings according to relevant standards and regulations.
23. Test and troubleshoot circuits containing passive and active electronic components.
24. Support the analysis and design of simple digital electronic systems
25. operate specialized software packages relevant to electrical and electronics engineering.
26. Support in the diagnoses and repairs of simple faults on computer hardware and application software.
27. Design and simulate electrical and electronics engineering systems.
28. Program Programmable Logic Controllers (PLCs)
29. Develop Human-Machine Interface (HMI) and Supervisory Control and Data Acquisition (SCADA) systems

3.0 GENERAL ENTRY REQUIREMENTS

The entry requirements for National Diploma in Electrical and Electronics Engineering Technology are:

a. A minimum score in the Unified Tertiary Matriculation Examination (UTME) as stipulated by JAMB
b. Five (5) Credit O-level passes at West African Senior School Certificate Examination (WASSCE), Senior School Certificate Examination (SSCE) or their equivalents at not more than TWO sittings. The five (5) subjects must include English Language, Mathematics, Physics, Chemistry and any other science subject.
c. The National Technical Certificate (NTC) or its equivalent in electrical and electronics trade with credit passes as in (b) above.

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4.0 DURATION

The duration of the programme is two academic sessions consisting of four semesters of 17 weeks per semester.

5.0 CURRICULUM

1. The curriculum of all ND programmes consists of four main components. These are:

    3.1 General studies/Education

    3.2 Foundation courses

    3.3 Professional courses

    3.4 Supervised Industrial Work Experience Scheme (SIWES)

2. The General Studies/Education component shall include courses in:
    i. *Art and Humanities* - English language, Communication. These are compulsory
    ii. Mathematics and Science
    iii. *Social Studies* - Citizenship, political science, sociology, philosophy, geography,entrepreneurship studies. The courses in citizenship, entrepreneurship are compulsory.

3. The General Studies/Education component shall account for not more than 15% of the total contact hours for the programme.
4. Foundation courses include courses in Mathematics, Pure Science, Computer Science, Technical Drawing, Descriptive Geometry and Statistics, etc. The number of hours will vary with the programme and may account for about 10-15% of the total contact hours depending on the programme.
5. Professional courses are courses which give the student the theory and practical skills he/she needs to practice in his/her field of specialization at the technician level. These may account for between 60-70% of the contact hours depending on the programme.

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6. Supervised Industrial Work Experience (SIWES) shall be taken during the long vacation following the end of the second semester of the first year. See detail of SIWES at Paragraph 10.0.

6.0 CURRICULUM STRUCTURE

The structure of the ND programme consists of four (4) semesters of class room, laboratory, field and workshop activities in the College and SIWES. Each semester shall be of seventeen (17) weeks duration made up as follows.

1. Fifteen (15) contact weeks of teaching, i.e lecture, test, quizzes, recitation, practical exercise, etc.
2. Two (2) weeks for the conduct of examinations. The SIWES registration shall take place at the end of the second semester of the first year for the ND programme.

7.0 ACCREDITATION

The programme offered at the ND level shall be accredited by the NBTE before the diplomates can be awarded ND Certificate. Details about the process of accreditation for the award of the ND programme is available from the Executive Secretary, National Board for Technical Education, Plot B, Bida Road, P.M.B 2239, Kaduna, Nigeria.

8.0 CONDITIONS FOR THE AWARD OF THE NATIONAL DIPLOMA

Institutions offering accredited programmes will award the National Diploma to candidates who successfully completed the programme after passing prescribed course work, examination, diploma project and the supervised industrial work experience. Such candidates should have completed a minimum of between 65 -75 semester credit units depending on the programme.

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8.1 Grading of Courses:

Courses shall be graded as follows:

Mark Range	Letter Grade	Weighting
75% and above	A	4.00
70% - 74%	AB	3.50
65% - 69%	B	3.25
60% - 64%	BC	3.00
55% - 59%	C	2.75
50% - 54%	CD	2.50
45% - 49%	D	2.25
40% - 44%	E	2.00
Below 40%	F	0.00

8.2 Classification of Diplomas: National Diplomas shall be classified as follows:

Distinction - CGPA of 3.50 - 4.00
Upper Credit - CGPA of 3.00 - 3.49
Lower Credit - CGPA of 2.50 - 2.99
Pass - CGPA of 2.00 - 2.49

9.0 QUALIFICATION OF THE TEACHERS

9.1 Holders of BSc / HND and Higher Degrees in:

i. Electrical/ Electronic Engineering,

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9.2 In addition, teachers of this programme should have been trained and certified by:

(a) Council for the Regulation of Engineering in Nigeria (COREN)

(b) Industrial certifications in Engineering

9.3 Headship of the Department:

Holders of HND or Bachelor's degree in any of the Electrical and Electronics Engineering

Higher Degree: Electronics and Communications, Instrumentation and Control, Power and Machines Engineering, who must not be below the rank of a Senior Lecturer

10.0 GUIDANCE NOTES FOR TEACHERS OF THE PROGRAMME

10.1 The new curriculum is drawn in unit courses. This is in keeping with the provisions of the National Policy on Education which stress the need to introduce the semester credit units that will enable a student who wish to transfer the units already completed in an institution of similar standards from which he is transferring.

10.2 In designing the units, the principle of the modular system by the product has been adopted; thus making each of the professional modules, when completed provides the students with technician operative skills, which can be used for the employment purposes. Also, he can move ahead for post ND studies.

10.3 As the success of the credit unit system depends on the articulation of the programmes between the institution and industry, the curriculum content has been written in behavioural objectives, so that it is clear to all, the expected performance of the student who successfully completed some of the courses to the diplomate of the programme. There is slight departure in the presentation of the performance-based curriculum which requires the conditions under which the performance are expected to be carried out and the criteria for the acceptable levels of performance. It is a deliberate attempt to further involve the staff of the department teaching the programme to write their own curriculum stating the conditions existing in their institution under which the performance can take place and to follow that with the criteria for determining an acceptable level of performance. Departmental submission of the final curriculum maybe vetted by the Academic Board of the institution for ensuring minimum standard and quality of education in the

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programmes offered throughout the polytechnic system.

10.4 The teaching of the theory and practical work should, as much as possible, be integrated. Practical exercises, especially those in professional course and laboratory work should be taught in isolation from the theory. For each course, there should be a balance of theory-practical in the ratio of 50:50 or 60:40 or the reverse.

11.0 GUIDELINES ON SIWES PROGRAMME

11.1 For the smooth operation of the SIWES, the following guidelines shall apply:

i. RESPONSIBILITY FOR PLACEMENT OF STUDENTS

Institution offering the ND programme shall arrange to place the students in the industry. Latest by April 30 of each year; six copies of the master list showing where each student has been placed shall be submitted to the Executive Secretary, NBTE which shall, in turn authenticate the list and forward it to the Industrial Training Fund (ITF), Jos.

ii. The Placement Officer should discuss and agree with industry on the following:

a) A task inventory of what the students should be expected to experience during the period of attachment. It may be wise to adopt the one already (ND) approved for each field.
b) The industry-based supervisor of the students during the period likewise the institution-based supervisor. The evaluation of the students during the period. It should be noted that the final grading of the student during the period of attachment should be weighted on the evaluation by his industry-based supervisor.

11.2 EVALUATION OF STUDENTS DURING SIWES

In the evaluation of the student, cognizance should be taken of the following items:

i. Punctuality

ii. Attendance

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iii. General Attitude to work

iv. Respect for authority

v. Interest in the field/technical area

vi. Technical competence as a potential technician in his field.

11.3 GRADING OF SIWES

To ensure uniformity of grading scale, the institution should ensure that uniform grading of student's work which has been agreed to by all polytechnics is adopted.

11.4 THE INSTITUTION BASED SUPERVISOR

The institution-based supervisor should endorse the logbook during each visit. This will enable him to check and determine to what extent the objectives of the scheme are being met and to assist students having any problem regarding the specific assignments given to them by their industry-based supervisor.

11.5 FREQUENCY OF VISIT

Institutions should ensure that students placed on attachment are visited within one month of their placement.

Other visits shall be arranged so that:

i. There is another visit six (6) weeks after the first visit; and
ii. A final visit in the last month of the attachment.

11.6 STIPEND FOR STUDENTS ON SIWES

The rate of stipend payable shall be determined from time to time by the Federal Government after due consultation with the Federal Ministry of Education, the Industrial Training Fund and the NBTE.

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11.7 SIWES AS A COMPONENT OF THE CURRICULUM

The completion of SIWES is important in the final determination of whether the student is successful in the programme or not. Failure in the SIWES is an indication that the student has not shown sufficient interest in the field or has no potential to become a skilled technician in his field. The SIWES should be graded also on credit unit system. Where a student has satisfied all other requirements but failed SIWES, he may only be allowed to repeat another four (4) months SIWES at his own expense.

11.8 LOGBOOK

The candidates are expected to record and up-keep a personal logbook. This will contain daily and weekly summary of curricular activities carried out by the candidates for each semester. The ND programme coordinator of the department will supervise the assessment and evaluation of the logbook.

12.0 FINAL YEAR PROJECT

Final year students in this programme are expected to carry out a project work. This could be on individual basis or group work. The project should, as much as possible incorporate basic element of design, drawing and complete fabrication of a marketable item or something that can be used. Project reports should be well presented and should be properly supervised. The departments should make their own arrangement of schedules for project work.

13.0 MANDATORY SKILLS QUALIFICATIONS (MSQ)

See guidelines for the implementation of MSQ in Polytechnics in Nigeria vide the NBTE website

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CURRICULUM TABLE

YEAR I SEMESTER I

Course Code	Course Title	L	P	CU	CH
GNS 101	Use of English I	2	0	2	2
GNS 111	Citizen Education I	2	0	2	2
MTH 112	Algebra and Elementary Trigonometry	2	0	2	2
MEC 111	Technical Drawing	1	3	3	4
MEC 113	Basic Workshop Technology and Practice	1	3	3	4
EEC 111	Electrical Drawings	1	3	3	4
EEC 112	Introduction to Digital Electronics	2	1	3	3
EEC 113	Technical Documentation and Report Writing	1	3	3	4
EEC 114	Electrical Engineering Science I	1	2	3	3
EEC 115	Industrial Health and Safety	1	1	2	2
MSQ	Mandatory Skills Qualification	0	0	0	2
TOTAL		**14**	**16**	**26**	**32**

* All GNS courses are to be obtained in GNS curriculum

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YEAR I SEMESTER II

Course Code	Course Title	L	P	CU	CH
GNS 102	Communication in English I	2	0	2	2
GNS 121	Citizenship Education II	2	0	2	2
ENT 126	Introduction to Entrepreneurship I	2	1	3	3
MTH 211	Calculus	2	0	2	2
EEC 121	Electrical Power I	1	2	2	3
EEC 122	Electrical Machine I	1	2	2	3
EEC 123	Electronics I	1	2	2	3
EEC 124	Electrical Engineering Science II	1	2	3	3
EEC 125	Electrical and Electronics measurement and Instrumentation	1	3	2	4
EEC 126	Telecommunications I	1	2	2	3
EEC 127	Electrical Installation of Buildings	1	2	2	3
MSQ	Mandatory Skills Qualification	0	0	0	2
TOTAL		**15**	**16**	**24**	**33**

* All GNS courses are to be obtained in GNS curriculum

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YEAR II SEMESTER I

Course Code	Course Title	L	P	CU	CH
GNS 211	Use of English II	2	0	2	2
ENT 216	Introduction to Entrepreneurship II	2	1	3	3
MTH 202	Logic and Linear Algebra	2	0	2	2
EEC 211	Electrical Power II	1	2	2	3
EEC 212	Electrical Machines II	1	2	2	3
EEC 213	Electronics II	1	3	3	4
EEC 214	Electrical Circuit Theory I	1	2	2	3
EEC 215	Use of Electrical and Electronics Instruments	1	2	2	3
EEC 216	Telecommunications II	1	2	2	3
EEC 217	Computer Hardware and Software I	1	2	2	3
EEC 218	Research Methods in Electrical Engineering	2	0	2	2
TOTAL		**15**	**16**	**24**	**31**

* All GNS courses are to be obtained in GNS curriculum

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YEAR II SEMESTER II

Course Code	Course Title	L	P	CU	CH
GNS 202	Communication in English II	2	0	2	2
MTH 221	Trigonometry and Analytical Geometry	2	0	2	2
EEC 221	Electrical Power III	1	2	2	3
EEC 222	Computer Hardware and Software II	1	2	2	3
EEC 223	Electronics III	1	2	3	4
EEC 224	Electrical Circuit Theory II	1	2	2	3
EEC 225	Introduction to Industrial Automation	2	2	3	4
EEC 226	Project	0	0	4	4
TOTAL		**10**	**10**	**20**	**25**

* All GNS courses are to be obtained in GNS curriculum

Key

L - Lecture
P - Practical
CU - Credit Unit
CH - Credit Hour

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YEAR ONE, SEMESTER ONE

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Algebra And Elementary Trigonometry

PROGRAMME: NATIONAL DIPLOMA IN ELECTRICAL AND ELECTRONICS ENGINEERING TECHNOLOGY		
COURSE: Algebra And Elementary Trigonometry	**COURSE CODE**: MTH 112	**CONTACT HOURS**: 2
	CREDIT UNITS: 2	**THEORETICAL:** 2
YEAR: I **SEMESTER:**	**PRE-REQUISITE**:	**PRACTICAL:** 0
GOAL: This course is designed to provide the students with mathematical knowledge and skills essential for solving a range of engineering problems		

GENERAL OBJECTIVES: On completion of this course, the students should be able to:

1.0 Understand the laws of indices and their application in simplifying Algebraic expressions.
2.0 Understand the theory of logarithms and surds and their applications in manipulating expressions.
3.0 Understand principles underlying the construction of charts and graphs.
4.0 Know the different methods of solving quadratic equations.
5.0 Understand Permutation and Combination.
6.0 Understand the set theory.
7.0 Understand the properties of arithmetic and geometric progressions.
8.0 Understand the binomial and its application in the expansion of expressions
9.0 Understand the basic concepts and manipulation of vectors and complex number and their applications to the solution of engineering problems.
10.0 Understand the definition, manipulation and application of trigonometric function.
11.0 Understand the concept of equations and methods solving different types of equations and apply same to engineering problem.

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PROGRAMME: NATIONAL DIPLOMA IN ELECTRICAL AND ELECTRONICS ENGINEERING TECHNOLOGY						
COURSE: Algebra And Elementary Trigonometry			**COURSE CODE**: MTH 112		**CONTACT HOURS**: 2	
			CREDIT UNIT: 2		**THEORETICAL**: 2	
YEAR: I **SEMESTER:** I			**PRE-REQUISITE**:		**PRACTICAL:** 0	
COURSE SPECIFICATION: THEORETICAL AND PRACTICAL						
GOAL: This course is designed to provide the students with mathematical knowledge and skills essential for solving a range of engineering problems						
General Objective 1.0: Understand laws of indices and their applications in simplifying algebra expressions**.**						
THEORETICAL CONTENT				PRACTICAL CONTENT		
Week	Specific Learning Outcome	Teacher's Activities	Resources	Specific Learning Outcome	Teacher's Activities	Resources
1	1.1 Define index. 1.2 Establish the laws of Indices. 1.3 Explain how to solve simple problems using the laws of indices.	Explain index Explain the laws of indices. Explain how to solve problems using the laws of indices.	Textbooks Journals White Board Marker Computer Projector Internet	Establish the laws of Indices. Solve problems using the laws of indices	Guide students to: Establish the laws of Indices. Solve problems using the laws of indices	Calculators
General Objective 2.0: Understand theory of logarithms surds and their applications in manipulating expression.						
2-3	2.1 Define logarithm 2.2 Establish the four basic laws of	Explain logarithm Explain the four basic laws of logarithm	Textbooks Journals White Board Marker	Solve simple logarithms problem.	Guide students to: Solve simple logarithms problem.	Calculator

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	logarithm. 2.3 Explain how to solve simple logarithms problem. 2.4 Define natural logarithm and common logarithm. 2.5 Define characteristic and mantissa. 2.6 Explain how to read the logarithmic table for given numbers. 2.7 Explain how to simplify numerical expressions using tables: e.g. 18D = $3/4JPC^2AM^B$ find D when J = 0935, 0 = 35, P = 1.6 10^6, C = 55, M = 00025	 Explain how to solve simple logarithmic problems. Explain natural logarithm and common logarithm Explain characteristic and mantissa. Explain how to read the logarithmic table for given numbers. Explain how to simplify numerical expressions using tables: e.g. 18D = $3/4JPC^2AM^B$ find D when J = 0935, 0 = 35, P = 1.6 10^6, C = 55, M = 00025 Π = 3.142	Computer Projector Internet Lecture Note			

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	Π = 3.142 2.8 Explain how to apply logarithm in solving non-linear equations. e.g. $y = ax^n$, logy=log a + n log x; $y = bc^x$, logy = logb + xlogc; $y = a + bx^n$, Log (y- a) = Logb + nlogx, 2.9 Define surds. 2.10 Explain how to reduce a surd into its simplest form. 2.11 Explain how to solve simple problems on surds.	Explain how to apply logarithm in solving non-linear equations. e.g. $y = ax^n$, logy=log a + n log x; $y = bc^x$, logy = logb + xlogc; $y = a + bx^n$, Log (y- a) = Logb + nlogx, Explain surds. Explain how to reduce a surd into its simplest form. Explain how to solve simple problems on surds.				
General Objective 3.0: Understand principles underlying the construction of charts and graphs.						
4	3.1 Explain how to construct graphs of functions such as: Y + ax = b, n = 1,	Explain how to construct graphs of functions such as: Y + ax = b, n = 1,	Textbooks Journals White Board Marker	Apply knowledge from 3.1in termination as laws from experimental data.	Guide students to: Apply knowledge from 3.1in termination as laws from experimental	Calculator

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	2Y= CST (a+a) Y= ax^k, including cases of asymbles. 3.2 Explain how to apply knowledge from 3.1in termination as laws from experimental data.	2Y= CST (a+a) Y= ax^k, including cases of asymbles. Explain how to apply knowledge from 3.1in termination as laws from experimental data.	Computer Projector Internet Lecture Note	Ask the students to draw graphs.	data. Ask the students to draw graphs.	
General Objective 4.0: Know the different methods of solving quadratic equations.						
5	4.1 Explain how to solve quadratic equation by factorisation. 4.2 Explain how to solve quadratic equations by method of completing squares. 4.3 Explain how to solve quadratic equations by formula. 4.4 Determine the roots.	Explain how to solve quadratic equation by factorisation. Explain how to solve quadratic equations by method of completing squares. Explain how to solve quadratic equations by formula. Determine the roots.	Textbooks Journals White Board Marker Computer Projector Internet Lecture Note	Solve quadratic equation by factorisation.	Guide students to: Solve quadratic equation by factorisation	Calculator

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	4.5 Explain how to form equations whose roots are given in different methods.	Explain how to form equations whose roots are given in different methods.				
General Objective 5.0: Understand Permutations and Combinations.						
6	5.1 Define permutation. 5.2 State examples of permutations. 5.3 Define combination. 5.4 State examples of combination. 5.5 Establish the theorem nPr=n!/[!] giving examples e.g.: number of ways of collecting two out of 8 balls.	Explain permutation. Explain examples of permutations. Explain combination. Explain examples of combination. Explain the theorem nPr=n!/[!] giving examples e.g.: number of ways of collecting two out of 8 balls.	Textbooks Journals White Board Marker Computer Projector Internet Lecture Note			
General Objective 6.0: Understand the concept of set theory.						
7	6.1 Establish ${}^{n}C_{r} = {}^{n}C_{n} - r$. 6.2 Define sets, subsets, and null sets.	Explain ${}^{n}C_{r} = {}^{n}C_{n} - r$. Explain sets, subset, and null sets	Textbooks Journals White Board Marker	Solve set theory problems using Venn diagrams.	Guide students to: Solve set theory problems using Venn diagrams	

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	6.3 Define union, inter-section and completion of sets. 6.4 Explain how to draw Venn diagrams to demonstrate the concepts in 6.1 – 6.3 above. 6.5 Explain how to calculate the size or number of elements in a given set.	Explain union, intersection and completion of sets. Explain how to draw Venn diagrams to demonstrate the concepts in 6.1 – 6.3 above. Explain how to calculate the size or number of elements in a given set.	Computer Projector Internet Lecture Note			

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General Objectives 7.0: Understand the properties of arithmetic and geometric progressions.						
8-9	7.1 Define an Arithmetic progression (A.P.). 7.2 Explain how to obtain the formula for nth term and the first n terms of an A. P. 7.3 Give examples of the above e.g. find the 20^{th} term of the series e.g.: 2, 4, 6, 8….. Find also the series of the first 20 terms. 7.4 Define geometric progression (G.P.) 7.5 Explain how to obtain the formula for the nth term and the first n terms of a geometric series.	Explain an Arithmetic progression (A.P.). Explain how to obtain the formula for nth term and the first n terms of an A. P. Explain examples of the above e.g. find the 20^{th} term of the series e.g.: 2, 4, 6, 8….. Find also the series of the first 20 terms. Explain geometric progression (G.P.) Explain how to obtain the formula for the nth term and the first n terms of a geometric series.	Textbooks Journals White Board Marker Computer Projector Internet Lecture Note	Obtain the formula for nth term and the first n terms of an A. P. Ask the students to apply progression to solve problems.	Guide students to: Obtain the formula for nth term and the first n terms of an A. P. Ask the students to apply progression to solve problems.	Calculator

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	7.6 State examples of 7.5 above e.g.; given the sequences 1/3, 1, 3 ¼ find the 20th term and hence the sum of the 1st 20 terms. 7.7 Define Arithmetic Mean (AM) and Geometric Mean (G.M.). 7.8 Define convergence of series. 7.10 Define divergence of series.	Explain examples of 7.5 above e.g.; given the sequences 1/3, 1, 3 ¼ find the 20th term and hence the sum of the 1st 20 terms. Explain Arithmetic Mean (AM) and Geometric Mean (G.M.). Explain convergence of series. Explain divergence of series.				
General Objectives 8.0: Understand the binomial theorem and its application of expressions in approximations.						
10	8.1 Explain the method of mathematical induction. 8.2 State the binomial theorem for a positive integral	Explain the method of mathematical induction. Explain the binomial theorem for a positive integral index.	Textbooks Journals White Board Marker Computer Projector Internet Lecture			

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	index.		Note			
	8.3 Explain how to expand expressions of the forms $(x=y)^2$, $(x^2-1)^8$ applying binominal theorem.	Explain how to expand expressions of the forms $(x=y)^2$, $(x^2-1)^8$ applying binominal theorem.				
	8.4 Explain how to find the coefficient of a particular term in the expansion of simple binomial expressions.	Explain how to find the coefficient of a particular term in the expansion of simple binomial expressions.				
	8.5 Explain how to find the middle term in the expansion of binomial expression	Explain how to find the middle term in the expansion of binomial expression				
	8.6 State the binomial theorem for a rational index.	Explain the binomial theorem for a rational index.				
	8.7 Explain how to expand expressions of the form: $(1=x)^{-1}$, $(1-x)^{1/2}$ (1-	Explain how to expand expressions of the form: $(1=x)^{-1}$, $(1-x)^{1/2}$ (1- x) applying				

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	x) applying binomial theorem. 8.8 Explain how to expand and approximate expressions of the type (1.001) n, $(0.998)^n$, $(1=x)^{1/2}$, $(-x)^-$ to a state degree of accuracy applying/scalar expression.	binomial theorem. Explain how to expand and approximate expressions of the type (1.001) n, $(0.998)^n$, $(1=x)^{1/2}$, $(-x)^-$ to a state degree of accuracy applying/scalar expression.				
General Objectives 9.0: Understand the basic concepts and manipulation of vectors and their applications to the solution of engineering problems.						
11 - 12	9.1 Define vectors 9.2 Explain the representations of vectors. 9.3 Define a position vector. 9.4 Define unit vector. 9.5 Explain scalar multiple of a vector. 9.6 List the	Explain vectors Explain the representations of vectors. Explain a position vector. Explain unit vector. Explain scalar multiple of a vector. Explain the	Textbooks Journals White Board Marker Computer Projector Internet Lecture Note	Apply the techniques of vectors to solve various problems Apply the parallelogram law in solving problems including addition and subtraction of vectors. Compute the resultant of coplanar forces acting at a point using algebraic and graphical	Guide students to: Apply the techniques of vectors to solve various problems Apply the parallelogram law in solving problems including addition and subtraction of vectors. Compute the resultant of coplanar forces acting at a point using algebraic and graphical	

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	characteristics of parallel vectors. 9.7 Identify quantities that may be classified as vector e.g. displacement, velocity, acceleration, force, etc. 9.8 Explain how to compute the modules of any given vector up to 2 and 3 dimensions. 9.9 State the parallelogram law in solving problems including addition and subtraction of vectors. 9.10 Explain how to apply the parallelogram law in solving	characteristics of parallel vectors Explain quantities that may be classified as vector e.g. displacement, velocity, acceleration, force, etc. Explain how to compute the modules of any given vector up to 2 and 3 dimensions. Explain the parallelogram law in solving problems including addition and subtraction of vectors. Explain how to apply the parallelogram law in solving problems including		method Apply the techniques of resolution and resultant to the solution of problems involving coplanar forces. Apply vectorial techniques in solving problems involving relative velocity. Compute the scalar product of given vectors. Compute the scalar product of given vectors. Calculate the direction ratios of given vectors. Calculate the angle between two vectors using the scalar	method Apply the techniques of resolution and resultant to the solution of problems involving coplanar forces. Apply vectorial techniques in solving problems involving relative velocity. Compute the scalar product of given vectors. Compute the scalar product of given vectors. Calculate the direction ratios of given vectors. Calculate the angle between two vectors using the scalar	

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	problems including addition and subtraction of vectors.	addition and subtraction of vectors.		product	product	
	9.11 Explain components of a vector	Explain components of a vector				
	9.12 Explain orthogonal components.	Explain orthogonal components.				
	9.12 Resolve a vector into its orthogonal components.	Explain a vector into its orthogonal components.				
	9.13 List characteristics of coplanar localized vectors	Explain characteristics of coplanar localized vectors				
	9.14 Define the resultant or composition of coplanar vectors.	Explain the resultant or composition of coplanar vectors.				
	9.15 Explain how to compute the resultant of coplanar	Explain how to compute the resultant of coplanar forces acting at a point				

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	forces acting at a point using algebraic and graphical method	using algebraic and graphical method				
	9.16 Explain how to apply the techniques of resolution and resultant to the solution of problems involving coplanar forces.	Explain how to apply the techniques of resolution and resultant to the solution of problems involving coplanar forces.				
	9.17 Explain how to apply vectorial techniques in solving problems involving relative velocity.	Explain how to apply vectorial techniques in solving problems involving relative velocity.				
	9.18 State the scalar product of two vectors.	Explain the scalar product of two vectors.				
	9.19 Explain how to compute the scalar product of given vectors.	Explain how to compute the scalar product of given vectors.				

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	9.20 Define the cross product of two vectors. 9.21 Explain how to calculate the direction ratios of given vectors. 9.22 Explain how to calculate the angle between two vectors using the scalar product.	Explain the cross product of two vectors. Explain how to calculate the direction ratios of given vectors. Explain how to calculate the angle between two vectors using the scalar product.				
General Objectives 10.0: Understand the concepts of equations and apply it to engineering problems.						
13-14	10.1 Explain the concept of equation, i.e. AX + B = D where A and B are expressions. 10.2 List different types of equations: • Linear • Quadratic • Cubic, etc.	Explain the concept of equation, i.e. AX + B = D where A and B are expressions. Explain different types of equations:- • Linear • Quadratic • Cubic, etc.	Textbooks Journals White Board Marker Computer Projector Internet Lecture Note	Solve carious equations as indicated in section 10. Apply algebraic and graphical methods in solving two simultaneous equations a linear equation and a quadratic	Guide students to: Solve carious equations as indicated in section 10. Apply algebraic and graphical methods in solving two simultaneous equations a linear	Calculator

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				equation	equation and a quadratic equation	
	10.3 State examples of linear simultaneous equations with two unknowns and simultaneous equations with at least one quadratic equation.	Explain examples of linear simultaneous equations with two unknowns and simultaneous equations with at least one quadratic equation		Apply the algebraic and graphical methods in solving two simultaneous and quadratic equations.	Apply the algebraic and graphical methods in solving two simultaneous and quadratic equations.	
	10.4 Explain how to apply algebraic and graphical methods in solving two simultaneous equations a linear equation and a quadratic equation	Explain how to apply algebraic and graphical methods in solving two simultaneous equations a linear equation and a quadratic equation		Apply determinants of order 2 and 3 in solving simultaneous linear equations.	Apply determinants of order 2 and 3 in solving simultaneous linear equations.	
	10.5 Explain how to apply the algebraic and graphical methods in solving two simultaneous and quadratic equations.	Explain how to apply the algebraic and graphical methods in solving two simultaneous and quadratic equations				
	10.6 Define a determinant	Explain a determinant of n^{th} order				

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	of n^{th} order. 10.7 Explain how to apply determinants of order 2 and 3 in solving simultaneous linear equations.	Explain how to apply determinants of order 2 and 3 in solving simultaneous linear equations				
General Objectives 11.0: Understand the definition, manipulation and application of trigonometric functions.						
15	11.1 Define the basic trigonometric ratios, sine, cosine and tangent of an angle. 11.2 Derive the other trigonometric ratios; cosecant, secant and cotangent using the basic trigonometric ratios in 11.1 above. 11.3 Derive identities involving the trigonometric ratios	Explain the basic trigonometric ratios, sine, cosine and tangent of an angle Explain the other trigonometric ratios: cosecant, secant and cotangent using the basic trigonometric ratios in 11.1 above Explain identities involving the trigonometric ratios of	Textbooks Journals White Board Marker Computer Projector Internet Lecture Note			

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	of the form; $Cos^2+Sin^2=1$, $Sec^2=1=tan2$, etc. 11.4 Derive the compound angle formulae for sin (A-B), Cos (A-B) and Tan (A-B).	the form: $Cos^2+Sin^2=1$, $Sec^2=1=tan2$, etc. Explain the compound angle formulae for sin A-B), Cos (A-B) and Tan (A-B).				

EVALUATION
C/A:40%
EXAMS: 60%
TOTAL: 100%

ASSESSMENT STRUCTURE

TYPE OF ASSESSMENT	PURPOSE AND NATURE OF ASSESSMENT	WEIGHTING (%)
Examination	Final Examination (written) to assess knowledge and understanding	60
Test	At least 2 progress tests for feedback.	20
Course Work	At least 5 home works to be assessed by the teacher	20
TOTAL		**100**

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Technical Drawing

PROGRAMME: NATIONAL DIPLOMA IN ELECTRICAL AND ELECTRONICS ENGINEERING TECHNOLOGY		
COURSE TITLE: Technical Drawing	**COURSE CODE**: MEC 111	**CONTACT HOURS**: 4
	CREDIT UNITS: 3	**THEORETICAL:** 1
YEAR: **SEMESTER:** I	**PRE-REQUISITE**:	**PRACTICAL:** 3
GOAL: This course is designed to acquaint students with the fundamentals of technical drawing and its applications in engineering technology		
GENERAL OBJECTIVES: On completion of this course, the students should be able to:		

1.0 Know different drawing instrument, equipment and materials
2.0 Understand the essentials of graphical communications
3.0 Know the construction of simple geometrical figures and sections
4.0 Know the Construction of isometric and oblique drawing and projection
5.0 Understand principles of orthographic projections.
6.0 Understand the intersections of regular solids

NATIONAL BOARD FOR TECHNICAL EDUCATION

PROGRAMME: NATIONAL DIPLOMA IN ELECTRICAL AND ELECTRONICS ENGINEERING TECHNOLOGY						
COURSE TITLE: Technical Drawing			**COURSE CODE**: MEC 111	**CONTACT HOURS**: 4		
			CREDIT UNITS: 3	**THEORETICAL:** 1		
YEAR: **SEMESTER:** I			**PRE-REQUISITE**:	**PRACTICAL:** 3		
GOAL: This course is designed to acquaint students with the fundamentals of technical drawing and its applications in engineering technology						
COURSE SPECIFICATION: THEORETICAL AND PRACTICAL CONTENT						
General Objective 1.0: Know different drawing instruments, equipment and materials						
THEORETICAL				PRACTICAL		
Week	**Specific Learning Outcomes**	**Teachers Activities**	**Resources**	**Specific Learning Outcomes**	**Teachers Activities**	Resources
1-2	1.1 List different types of drawing instruments, equipment and materials. 1.2 Outline the uses of the various instruments, equipment and materials 1.3 State the precautions necessary to preserve items 1.1 above.	Explain different types of drawing instruments, equipment and materials Explain the uses of the various instruments, equipment and materials Explain the precautions necessary to preserve items 1.1 above	Marker Whiteboard Journals Textbooks Computer Internet Projector	Identify the different types of drawing instruments, equipment and materials. Observe the precautions necessary to preserve the items identified above. Use each of the items mentioned	Guide students to: Identify the different types of drawing instruments, equipmen and materials. Observe the precautions necessary to preserve the items identified above. Use each of the items mentioned above.	Complete set of drawing instruments Drawing Boards

				above. Maintain the various instruments and equipment.	Maintain the various instruments and equipment.	
General Objective 2.0: Understand the essentials of graphical communications						
3-4	2.1 Explain different types of graphic Communications. 2.2 Describe various conventions present in graphical productions of construction lines, finished lines, hidden and overhead details projections, centre lines, break lines, dimensioning of plane, elevation and sections of objects. 2.3 State the various standards of drawing sheets. 2.4 Explain how to print letters and figures of various forms and characters.	Explain different types of graphic Communications. Explain various conventions present in graphical productions of construction lines, finished lines, hidden and overhead details projections, centre lines, break lines, dimensioning of plane, elevation and sections of objects. Explain the various standards of drawing sheets. Explain how to print	Marker Whiteboard Journals Textbooks Computer Internet Projector	Illustrate the various conventions present in graphical productions of construction lines, finished lines, hidden and overhead details projections, centre lines, break lines, dimensioning of plane, elevation and sections of objects. Prepare drawing sheets with the following:	Guide students to: Illustrate the various conventions present in graphical productions of construction lines, finished lines, hidden and overhead details projections, centre lines, break lines, dimensioning of plane, elevation and sections of objects. Prepare drawing sheets with the following: • Margins • Title block etc.	Complete set of drawing instruments Drawing Boards

	2.5 Describe conventional signs, symbols and appropriate lettering characters	letters and figures of various forms and characters. Explain conventional signs, symbols and appropriate lettering characters		• Margins • Title block etc. State the various standards of drawing sheets. Print letters and figures of various forms and characters. Illustrate conventional signs, symbols and appropriate lettering characters.	State the various standards of drawing sheets. Print letters and figures of various forms and characters. Illustrate conventional signs, symbols and appropriate lettering characters.	
General Objective 3.0: Know the construction of simple geometrical figures and sections						
5-7	3.1 Explain the purpose of geometrical construction in drawing parallel lines. 3.2 Define geometric figures: • Circle • Quadrilateral • Polygon, etc.	Explain the purpose of geometrical construction in drawing parallel lines. Explain geometric figures • Circle • Quadrilateral	Marker Whiteboard Journals Textbooks Computer Internet Projector	Construct parallel and perpendicular lines. Construct and bisect lines, angles and areas.	Guide students to: Construct parallel and perpendicular lines. Construct and bisect lines, angles and	Complete set of drawing instruments Drawing Boards

	3.3 Explain the properties of geometric figures, e.g.: • Sides • Diagonal • Radius • Diameter • Normal • Tangent • Circumference etc. 3.4 Explain the steps in construction of simple geometrical figures and sections 3.4 Define an ellipse. 3.5 Explain the following drafting techniques: • Projection method • Measurement method • Transposition method.	• Polygon, etc. Explain the properties of geometric figures, e.g.: • Sides • Diagonal • Radius • Diameter • Normal • Tangent • Circumference etc. Explain the steps in construction of simple geometrical figures and sections Explain an ellipse. Explain the following drafting techniques: • Projection method • Measurement method • Transposition method.		Divide a straight line into given number of equal parts. Identify polygons (regular or irregular). Construct regular polygons with N sides in a given circle, given: • Distance across flats • Distance across corners. Carryout simple geometrical constructions on circles e.g.: • Diameter of a circle of a circle of a given circumferenc	areas. Divide a straight line into given number of equal parts. Identify polygons (regular or irregular). Construct regular polygons with N sides in a given circle, given: • Distance across flats • Distance across corners. Carryout simple geometrical constructions on circles e.g.: • Diameter of a circle of a circle of a given circumference. • The	

				e. • The circumferenc e to a circle of a given diameter • A circle to pass through 3 points • A circle to pass through 2 points and touch a given line • A circle to touch a given smaller circle and a given line • Tangents to circles at various points • An arc of radius tangent to two lines at an angle to	circumference to a circle of a given diameter • A circle to pass through 3 points • A circle to pass through 2 points and touch a given line • A circle to touch a given smaller circle and a given line • Tangents to circles at various points • An arc of radius tangent to two lines at an angle to less than and more than 90 • An arc externally tangent to two circles: inscribing and circumscribing circles	

				less than and more than 90 • An arc externally tangent to two circles: inscribing and circumscribing circles Construct ellipse by using: • Trammel method • Concentric circle method. Construct plane scales and diagonal scales, using appropriate instruments.	Construct ellipse by using: • Trammel method • Concentric circle method. Construct plane scales and diagonal scales, using appropriate instruments.	
General Objective 4.0: Know the construction of isometric and oblique drawing and projection						
8-10	4.1 Explain isometric and oblique projections. 4.2 Explain steps in construction	Explain isometric and oblique projections Explain steps in	Marker Whiteboard Journals Textbooks	Draw a square in isometric and	Guide students to: Draw a square in isometric and oblique	Complete set of drawing instruments

	of isometric and oblique drawing and projection	construction of isometric and oblique drawing and projection	Computer Internet Projector	oblique forms. Draw a circle in Isometric and oblique forms. Draw an ellipse in Isometric and oblique forms. Draw a polygon with a minimum of eight sides in Isometric and oblique forms. Dimension holes, circles, arcs and angles correctly on isometric and oblique projections. Use appropriate convention symbols and abbreviations.	forms. Draw a circle in Isometric and oblique forms. Draw an ellipse in Isometric and oblique forms. Draw a polygon with a minimum of eight sides in Isometric and oblique forms. Dimension holes, circles, arcs and angles correctly on isometric and oblique projections. Use appropriate convention symbols and abbreviations.	Drawing Boards

NATIONAL CURRICULUM AND ASSESSMENT

General Objective 5.0: Understand principles of orthographic projections						
11-13	5.1 Explain the principle of orthographic projection. 5.2 Illustrate the principle planes of projection: • Vertical plane • Horizontal plane. 5.3 Explain why the first and third angles are used and the second and fourth angles not used.	Explain the principle of orthographic projection. Explain the principle planes of projection: • Vertical plane • Horizontal plane. Explain why the first and third angles are used and the second and fourth angles not used.	Marker Whiteboard Journals Textbooks Computer Internet Projector	Project views of three-dimensional objects on to the basic planes of projection in both first and third angle to obtain: • The front view or elevation • The top view or plan. • The side view	Guide students to: Project views of three-dimensional objects on to the basic planes of projection in both first and third angle to obtain: • The front view or elevation • The top view or plan. • The side view	Complete set of drawing instruments Drawing Boards
General Objective 6.0: Understand the intersections of regular solids						
12 –15	6.1 Explain interpretation or intersections of solids 6.2 Explain the intersections of regular solids .	Explain interpretation or intersections of solids. Explain the intersections of regular solids	Marker Whiteboard Journals Textbooks Computer Internet Projector	Draw the lines of intersections of the following regular solids and planes in both first and third angles. • Two square-prisms meeting at right angles. • Two dissimilar	Guide students to: Draw the lines of intersections of the following regular solids and planes in both first and third angles. • Two square-prisms meeting at right angles. • Two dissimilar square prisms	Complete set of drawing instruments Drawing Boards

				square prisms meeting at an angle. • Two dissimilar square prisms meeting to an angle • A hexagonal prism meeting a square prism at right angles. • Two dissimilar cylinders meeting at an angle. • Two dissimilar cylinders meeting at right angle, their centres not being in the same vertical plane	meeting at an angle. • Two dissimilar square prisms meeting to an angle • A hexagonal prism meeting a square prism at right angles. • Two dissimilar cylinders meeting at an angle. • Two dissimilar cylinders meeting at right angle, their centres not being in the same vertical plane	

Basic Workshop Practice and Technology

PROGRAMME: NATIONAL DIPLOMA IN ELECTRICAL AND ELECTRONICS ENGINEERING TECHNOLOGY		
COURSE TITLE: Basic Workshop Practice and Technology	**COURSE CODE**: MEC 113	**CONTACT HOURS**: 4
	CREDIT UNITS: 3	**THEORETICAL:** 1
YEAR: **SEMESTER:** I	**PRE-REQUISITE**:	**PRACTICAL:** 3
GOAL: This course is designed to acquaint students with knowledge and skills of workshop safety practices as well as the use and care of basic tools and equipment in workshop operations		
GENERAL OBJECTIVES: On completion of this course, the students should be able to: 1.0 Know General Factory Acts, Safety Regulations and safety precautions 2.0 Understand safety inspection 3.0 Use basic marking out, metal removal and filing tools 4.0 Use basic measuring and testing equipment 5.0 Perform drilling operations 6.0 Perform various metal joining operations 7.0 Perform the various wood working tools and operations 8.0 Perform reaming operations 9.0 Perform tapping operations 10.0 Perform basic operations on plastics		

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PROGRAMME: NATIONAL DIPLOMA IN ELECTRICAL AND ELECTRONICS ENGINEERING TECHNOLOGY						
COURSE TITLE: Basic Workshop Technology and Practice			**COURSE CODE**: MEC 113		**CONTACT HOURS**: 4	
			CREDIT UNITS: 3		**THEORETICAL:** 1	
YEAR: **SEMESTER:** I			**PRE-REQUISITE**:		**PRACTICAL:** 3	
COURSE SPECIFICATION: **THEORETICAL AND PRACTICAL CONTENT**						
GOAL: This course is designed to acquaint students with knowledge and skills of workshop safety practices as well as the use and care of basic tools and equipment in workshop operations						
General Objective 1.0: Know General factory acts, safety Regulations and safety precautions						
THEORETICAL				PRACTICAL		
Week	**Specific Learning Outcome**	**Teachers' Activities**	**Resources**	**Specific Learning Outcome**	**Teachers' Activities**	**Resources**
1-2	1.1 Explain Nigeria Factories Acts and Safety Regulations 1.2 Explain safety Rules and Regulations. 1.3 Explain standard housekeeping and its procedures 1.4 State safety precautions	Explain Nigeria Factories Acts and Safety Regulations Explain safety Rules and Regulations. Explain standard housekeeping and its procedures State safety precautions Provide list of safety	Lecture notes Textbooks Whiteboard Marker Computer Projector Internet	Demonstrate all safety rules and regulations in the workshop Use safety equipment and Personal Protection Equipment Follow safety procedures and precautionary measures	Guide students to: Demonstrate all safety rules and regulations in the workshop Use safety equipment and Personal Protection Equipment Follow safety procedures and precautionary measures	Videos of safe and unsafe acts Safety charts Personal Protective equipment

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	1.5 Provide list of safety precautions in the workshop 1.6 Explain some unsafe acts in the workshop. 1.7 List out protective wears in the workshop. 1.8 Explain Personal Protective Equipment (PPE) such as: • Safety boots • Goggles • Coverall • Hand gloves, etc.	precautions in the workshop Explain some unsafe acts in the workshop. List out protective wears in the workshop. Explain Personal Protective Equipment (PPE) such as: • Safety boots • Goggles • Coverall • Hand gloves, etc.		measures		
General Objective 2.0: Understand safety inspection						
3	2.1 Define safety inspections 2.2 Describe different types of safety inspections 2.3 Explain the importance of safety inspection in the workshop	Explain safety inspections Explain different types of safety inspections Explain the importance of safety inspection in	Lecture notes Textbooks Whiteboard Marker Computer Projector Internet	Inspect the following equipment in the workshops: • Air receivers • Ropes and Chains	Guide students to: Inspect the following equipment in the workshops: • Air receivers • Ropes and Chains	Videos of safe and unsafe acts Safety charts Personal Protective

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	2.4 State frequency of safety inspections and personnel to be involved 2.5 Explain how to carry out safety inspections on the following equipment: • Air receivers • Ropes and Chains • Pulley blocks • Forklift carriage • Mobile and overhead cranes • Derricks and gantries 2.6 Emphasize the use of relevant personal protective equipment while on inspection	the workshop Explain frequency of safety inspections and personnel to be involved Explain how to carry out safety inspections on the following equipment: • Air receivers • Ropes and Chains • Pulley blocks • Forklift carriage • Mobile and overhead • Derricks and gantries Explain the use of relevant personal protective equipment while on inspection		• Pulley blocks • Forklift carriage • Mobile and overhead cranes • Derricks and gantries	• Pulley blocks • Forklift carriage • Mobile and overhead cranes • Derricks and gantries	equipment
General Objective 3.0: Use basic marking out, metal removal and filing tools						
4-5	3.1 Describe types of marking-out tools and how to use it on the bench	Explain types of marking-out tools and how to use it on the	Lecture notes Textbooks Whiteboard	Differentiate between:	Guide students to Differentiate between: • Hand tools and	Work bench Bench vice

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	correctly 3.2 Explain the need for care in the use of the tools 3.3 Explain the effect of not using this tools properly and keeping them in good working condition 3.4 Explain how to maintain: • Files • Dividers • Saws • Gauges • Tri squares • Bevel edge square etc. 3.5 Explain the role of the following tools in the mechanical workshop: • Scribers • Inside and outside caliper • Centre • Files • Scrapers	bench correctly Explain the need for care in the use of the tools Explain the effect of not using this tools properly and keeping them in good working condition Explain how to maintain: • Files • Dividers • Saws • Gauges • Tri squares • Bevel edge square etc. Explain the role of the following tools in the mechanical workshop: • Scribers • Inside and outside caliper • Centre • Files • Scrapers	Marker Computer Projector Internet	• Hand tools and machine tools • Bench tools and machine cutting tools Identify marking out tools used on the bench typical workshop practical exercises. Use marking-out tools on the bench correctly Identify this bench cutting tools Produce simple objects using bench/hand tools such as: • Files • Chisels • Scrapers • Saws etc.	machine tools • Bench tools and machine cutting tools Identify marking out tools used on the bench typical workshop practical exercises. Use marking-out tools on the bench correctly Identify this bench cutting tools Produce simple objects using bench/hand tools such as: • Files • Chisels • Scrapers • Saws etc. Maintain files, dividers, saws, gauges try squares, bevel	Hammers Set of drills Steel rule Scribers Scribing blocks Inside and outside calipers Surface plate Dividers Centre punches Files Scrapers

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	• File card	• File card		Maintain files, dividers, saws, gauges try squares, bevel edge square etc. Write process sheet or operation layout for the component to be produced.	edge square etc. Write process sheet or operation layout for the component to be produced.	
General Objective 4.0: Use basic measuring and testing equipment						
6-7	4.1 Explain the methods of using the measuring equipment 4.2 Explain the advantage of using the equipment properly and keeping them in good working condition 4.3 Explain: • The principle of operation and construction of a micrometer screw gauge	Explain the methods of using the measuring equipment Explain the advantage of using the equipment properly and keeping them in good working condition Explain: • The principle of operation and construction of a micrometer screw gauge • The least count of	Lecture notes Textbooks Whiteboard Marker Computer Projector Internet	Identify the differences and similarities between measuring and testing equipment in mechanical workshop with regards to: • Principle of operation • Construction • Use Perform simple measuring exercises using steel rules,	Guide students to: Identify the differences and similarities between measuring and testing equipment in mechanical workshop with regards to: • Principle of operation • Constructio n • Use Perform simple measuring	Micrometers-external & internal Vernier calipers Steel rule Test mandrel/test bar 070 x 300 mm long dial indicator

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	• The least count of micrometer • Principle of operation and construction of a Vernier caliper and the least count. • The types of micrometers • The types of Vernier calipers • Accuracy of a steel rule 4. 2 Explain the principle and construction of a dial indicator, their types and their accuracy 4.3 Differentiate between the use of vernier protractor and sine bar and their limitations.	micrometer • Principle of operation and construction of a Vernier caliper and the least count. • The types of micrometers • The types of Vernier calipers • Accuracy of a steel rule Explain the principle and construction of a dial indicator, their types and their accuracy Differentiate between the use of vernier protractor and sine bar and their limitations.		vernier calipers and micrometers. Use dial indicators to: • Set up jobs on the lathe • Roundness testing etc. Carry out exercises involving flatness, squareness, straightness and surface finish test. Perform taper measurement on jobs using vernier protractor and sine bars. Inspect jobs using simple comparators	exercises using steel rules, vernier calipers and micrometers. Use dial indicators to: • Set up jobs on the lathe • Roundnes s testing etc. Carry out exercises involving flatness, squareness, straightness and surface finish test. Perform taper measurement on jobs using vernier protractor and sine bars. Inspect jobs using simple comparators	with stand spirit level surface Roughness tester (portable type) SURF TEST, 90° angle gauge straight edge Vernier protractor.

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General Objective 5.0: Perform drilling operations						
8-9	5.1 Explain the nomenclature of a twist drill 5.2 Explain types of drilling machine • Pillar • Column • Multi spindle etc. 5.3 Explain the type of drilling operation that can be carried out on the following: • Radial drilling machine • Bench drilling machine • Pillar drilling machine • Column type drilling machine 5.4 Differentiate between: • Drilling and boring	Explain the nomenclature of a twist drill Explain types of drilling machine • Pillar • Column • Multi spindle etc. Explain the type of drilling operation that can be carried out on the following: • Radial drilling machine • Bench drilling machine • Pillar drilling machine • Column type drilling machine Explain the differences between: • Drilling and boring	Lecture notes Textbooks Whiteboard Marker Computer Projector Internet	Operate different types of drilling machine Carry out drilling operations such as: • Counter-boring • Counter-sinking Grind drill bits accurately Select correct drilling speeds Indicate the nomenclature of a twist drill: • Clearance angle • Rake angle • Point angle etc.	Guide students to: Operate different types of drilling machine Carry out drilling operations such as: • Counter-boring • Counter-sinking Grind drill bits accurately Select correct drilling speeds Indicate the nomenclature of a twist drill: • Clearance angle • Rake angle • Point	Radial drilling machine Bench drilling machine Pillar drilling machine Column type drilling machine Counter boring drills Counter sinking drills Centre drills Pedestal grinding machine attached with a twist drill grinding

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	operations • Radial drilling and sensitive drilling machine 5.5 Explain the formulae for calculation of speed of various sizes of drills	operations • Radial drilling and sensitive drilling machine Explain the formulae for calculation of speed of various sizes of drills		Calculate the speeds of various sizes of drills using appropriate formulae.	angle etc. Calculate the speeds of various sizes of drills using appropriate formulae.	attachment
General Objective 6.0: Perform various metal joining operations						
10-11	6.1 Explain the various metal joining methods 6.2 Describe the process of joining metals using the following methods: • Brazing • Threaded Fasteners • Soldering 6.3 Explain how to carry out soft soldering	Explain the various metal joining methods Explain the process of joining metals using the following methods: • Brazing • Threaded Fasteners • Soldering Explain how to carry out soft soldering	Lecture notes Textbooks Whiteboard Marker Computer Projector Internet	Identify various metal joining operations Fabricate metal container by Knock-up joining Join metals by the grooving technique Fabricate metal container by knock-up joining Carry out soft soldering	Guide students to: Identify various metal joining operations Fabricate metal container by Knock-up joining Join metals by the grooving technique Fabricate metal container by knock-up joining Carry out soft soldering	Various types of Fasteners Brazing rods Flash gas lighter Soldering flux Stock and dies (set) metric

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General Objective 7.0: Perform the various wood working tools and operations						
12	7.1 Explain the applications of the following: • Geometric/marking out tools e.g. tri square, dividers and gauges • Planning tools e.g.: Jack, smooth, spoke shaves, etc. • Cutting tools e.g.: saws, chisels, knives, boring tools • Impelling tools e.g.: hammer and mallets, Pneumatic tools 7.2 Describe portable electric hand tools in wood work, e.g.: • Portable saw • Portable planer • Portable drill • Portable sander • Jig saw.	Explain the applications of the following: • Geometric/marking out tools e.g. tri square, dividers and gauges • Planning tools e.g.: Jack, smooth, spoke shaves, etc. • Cutting tools e.g.: saws, chisels, knives, boring tools • Impelling tools e.g.: hammer and mallets, Pneumatic tools Explain portable electric hand tools in wood work, e.g.: • Portable saw • Portable planer • Portable drill • Portable	Lecture notes Textbooks Whiteboard Marker Computer Projector Internet	Identify the tools used for wood work Mark out and prepare wood for various operations as described in 7.2 Carry out various woodwork operations using the tools in 7.1 -7.3 Maintain all tools and machines used Identify the steps and tools involved in making a simple machine part using wood as material	Identify the tools used for wood work Mark out and prepare wood for various operations as described in 7.2 Carry out various woodwork operations using the tools in 7.1 - 7.3 Maintain all tools and machines used Identify the steps and tools involved in making a simple machine part using wood as material	Tri Square Divider Gauges Jack planes Smooth plane Panel saws Chisels Knives Boring tools Hammers Mallets Portable saw Portable planer Portable drill

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	7.3 Explain the operations of basic wood working machines such as: • Surface plaining and thickening machine:- Circular sawing Machine • Mortising machine:- Drilling machine • Single ended plaining machine • Band sawing machines and safety precaution in their operations 7.4 Explain the need for care in the use of the tools and machines listed in 7.1 – 7.3 7.5 Explain the methods of maintenance of the tools and machines listed in 7.1 – 7.3	sander • Jig saw. Explain the operations of basic wood working machines such as: • Surface plaining and thickening machine:- Circular sawing Machine • Mortising machine:-Drilling machine • Single ended plaining • Band sawing machines and safety precaution in their operations Explain the need for care in the use of the tools and machines listed in 7.1 – 7.3 Explain the methods of				Portable sander Jig saw

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	7.6 State the safety precaution on the tools and machines listed in 7.1 – 7.3	maintenance of the tools and machines listed in 7.1 – 7.3 Explain the safety precaution on the tools and machines listed in 7.1 – 7.3				
General Objective 8.0: Perform reaming operations						
13	8.1 Describe reaming Operations 8.2 Explain how to carry out reaming operations 8.3 Explain the need for care in the use of the tools and machines for reaming operations 8.4 Explain the methods of maintenance of the tools and machines for reaming operations 8.5 Explain the conditions for using the following tools in reaming operations: • Hand reamers	Explain reaming Operations Explain how to carry out reaming operations Explain the need for care in the use of the tools and machines for reaming operations Explain the methods of maintenance of the tools and machines for reaming operations Explain the conditions for using the following tools in reaming operations:	Lecture notes Textbooks Whiteboard Marker Computer Projector Internet	Carry out reaming operations: • on the bench • on drilling/lathe Select correct speeds for reaming small and large holes	Guide students to: Carry out reaming operations: • on the bench • on drilling/lathe Select correct speeds for reaming small and large holes	Hand reamers Machine reamers Tap wrench Jacobs chuck and key Reduction sleeves Radial drilling machine Reamers

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	• Machine reamers • Tap wrench • Radial drilling machine	• Hand reamers • Machine reamers • Tap wrench • Radial drilling machine				
General Objective 9.0: Perform tapping operations						
14	9.1 Explain tapping and the purpose of tapping operation. 9.2 Explain the need for care in the use of the tools and machines for tapping operations 9.3 Explain how to calculate tapping drill sizes 9.4 Explain the characteristics of threaded fasteners: • Pitch • No. of starts • Profile of thread • Direction of thread	Explain tapping and the purpose of tapping operation. Explain the need for care in the use of the tools and machines for tapping operations Explain how to calculate tapping drill sizes Explain the characteristics of threaded fasteners: • Pitch • No. of starts • Profile of thread • Direction of thread	Lecture notes Textbooks Whiteboard Marker Computer Projector Internet	Select correct tapping drill size Select correct taps Carry out tapping operation: • On the work bench • On drilling machine • On lathe Calculate tapping drill sizes	Guide students to: Select correct tapping drill size Select correct taps Carry out tapping operation: • On the work bench • On drilling machine • On lathe Calculate tapping drill sizes	Taps and wrenches Drill chuck and key Lathe machine medium size Pillar drilling machine

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	9.5 State the correct tapping drill size. 9.6 Explain how to correct Taps	Explain the correct tapping drill size. Explain how to correct Taps				
General Objective 10.0: Perform basic operations on plastics						
15	10.1 Explain various types of plastic groups such as: • Thermo-setting • Thermo-plastic 10.2 Explain characteristics of each type of plastic. 10.3 Explain the three processes of joining plastics together 10.4 Differentiate between thermo-setting and thermo-plastics. 10.5 Describe how to use conventional metal cutting tools to perform operations on plastics.	Explain various types of plastic groups such as: • Thermo-setting • Thermo-plastic Explain characteristics of each type of plastic. Explain the three processes of joining plastics together Explain the differences between thermo-setting and thermo-plastics. Explain how to use conventional metal	Lecture notes Textbooks Whiteboard Marker Computer Projector Internet	Identify various types of plastic groups Identify the characteristics of each type of plastic. Use conventional metal cutting tools to perform operations on plastics. Carryout joining operations using plastics	Guide students to: Identify various types of plastic groups Identify the characteristics of each type of plastic. Use conventional metal cutting tools to perform operations on plastics. Carryout joining operations using plastics	Set of drill Wood turning lathe HSS cutting tools Evostic glue Thermo-setting and thermo-plastic

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	10.6 Explain the result of using conventional metal cutting tools for operation on thermo-setting and thermo-setting plastic.	cutting tools to perform operations on plastics. Explain the result of using conventional metal cutting tools for operation on thermo-setting and thermo-setting plastic.				

EVALUATION

CA: 60%

EXAMINATION: 40%

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Electrical Drawings

PROGRAMME: NATIONAL DIPLOMA IN ELECTRICAL AND ELECTRONICS ENGINEERING TECHNOLOGY		
COURSE TITLE: Electrical Drawings	**CODE:** EEC 111	**CONTACT HOURS:** 4
	CREDIT UNITS: 3	**THEORETICAL:** 1
YEAR: I **SEMESTER:** I	**PRE-REQUISITE**:	**PRACTICAL:** 3
GOAL: This course is designed to acquaint student with the knowledge and skills to draw and interpret electrical and electronics engineering drawings.		
GENERAL OBJECTIVES: On completion of this course, the student should be able to:		

1.0 Understand symbols of electrical and electronic components
2.0 Know how to read and interpret Electrical and Electronic drawings.
3.0 Know how to draw diagrams for electrical and electronic circuits using standard symbols.
4.0 Understand how to draw diagrams using dedicated Computer Aided Design (CAD) software.

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PROGRAMME: NATIONAL DIPLOMA IN ELECTRICAL AND ELECTRONICS ENGINEERING TECHNOLOGY						
COURSE TITLE: Electrical Drawings		**CODE:** EEC 111		**CONTACT HOURS:** 4		
		CREDIT UNITS: 3		**THEORETICAL:** 1		
YEAR: I **SEMESTER:** I		**PRE-REQUISITE**:		**PRACTICAL:** 3		
COURSE SPECIFICATION: THEORETICAL AND PRACTICAL CONTENT						
GOAL: This course is designed to acquaint student with the knowledge and skills to draw and interpret electrical and electronics engineering drawings.						
GENERAL OBJECTIVE 1.0: Understand symbols of electrical and electronics components						
THEORETICAL				**PRACTICAL**		
Week	Specific Learning Outcome	Teachers' Activities	Resources	Specific Learning Outcome	Teachers' Activities	Resources
1-2	1.1 Define electrical symbols: • Machines • Wiring diagrams with codes • Switch gear, fuses, relays etc. • Voltage sources and current sources • Transformer. 1.2 Define electronics symbols: • Semi-conductor devices.	Explain electrical symbols: • Machines • Wiring diagrams with codes • Switch gear, fuses, relays etc. • Voltage sources and current sources • Transformer. Explain electronics symbols: • Semi-conductor devices.	Textbooks Journals Whiteboard Marker Computer Projector	Identify electrical and electronic symbols Identify different standards of symbols	Guide students to: Identify electrical and electronic symbols Identify different standards of symbols	Different symbols standards Videoclips Pictorials Free Version for students PC Schematic software Free Version for students E-plan software

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	• Integrated chips of the 74 series. • Resistors, Capacitors, Inductors 1.3 Explain types of electrical and electronics symbols 1.4 Explain different standards of symbols: • IEC • IEEE • ANSI • JEC	• Integrated chips of the 74 series. • Resistors, Capacitors, Inductors Explain types of electrical and electronics symbols Explain different standards of symbols: • IEC • IEEE • ANSI • JEC				
General Objective 2.0: Know how to read and interpret Electrical and Electronic drawings.						
3-5	**2.3** Explain electrical and electronic drawings **2.4** Explain types of electrical drawings: • Single Line • Multi Line **2.5** Explain types of	Explain electrical and electronic drawings Explain types of electrical drawings: • Single Line • Multi Line Explain types of electronic	Textbooks Journals Whiteboard Marker Computer Projector	Interpret Electrical, Building and Electronic diagrams. Draw Symbolic Electrical circuits Draw Building wiring	Guide students to: Read and interpret Electrical, Building and Electronic diagrams.	Templates, Drawing Materials and equipment, Computer Systems Sample electrical

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	electronic drawings **2.6** Distinguish between SYMBOLIC and COMPONENT diagrams. **2.7** Explain how to read electrical and electronic drawings **2.8** Explain how to interpret electrical and electronic drawings **2.9** Explain the importance of reading and interpreting electrical and electronic drawings appropriately	drawings Explain the differences between SYMBOLIC and COMPONENT diagrams. Explain how to read electrical and electronic drawings Explain how to interpret electrical and electronic drawings Explain the importance of reading and interpreting electrical and electronic drawings appropriately		diagrams showing all components, wiring, conduits, switch boxes, wall plugs. Draw a simple electrical circuit with voltage and current source and other circuit elements.	Draw Symbolic Electrical circuits Draw Building wiring diagrams showing all components, wiring, conduits, switch boxes, wall plugs. Draw a simple electrical circuit with voltage and current source and other circuit elements.	drawings Sample electronic drawings
GENERAL OBJECTIVE 3.0: Know how to draw diagrams for electrical and electronic circuits using standard symbols						
6-10	3.1 Explain standard symbols 3.2 Explain simple electrical installation diagrams using standard symbols. 3.3 Explain electronic circuits using standard	Explain standard symbols Explain simple electrical installation diagrams using standard symbols. Explain electronic circuits using standard symbols	Textbooks Journals Whiteboard Marker Computer Projector	Identify standard symbols Perform Power experiments" from the	Guide students to: Identify standard symbols Perform Power experiments"	Templates Drawing Materials and equipment Computer Systems

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	symbols 3.4 Explain Machine diagrams 3.5 Explain redline drawings and as-built	Explain Machine diagrams Explain redline drawings and as-built		symbolic diagrams to wiring diagrams showing terminals and earth points and how " 2 channel Oscilloscopes" should be connected without shorting the circuit. Draw a typical electrical installation project using standard symbols. Draw electronic circuits using standard symbols Identify machine diagrams	from the symbolic diagrams to wiring diagrams showing terminals and earth points and how " 2 channel Oscilloscopes" should be connected without shorting the circuit. Draw a typical electrical installation project using standard symbols. Draw electronic circuits using standard symbols Identify machine diagrams	Sample electrical drawings Sample electronic drawings Sample standard symbols Sample redline markings

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				Identify redline drawings Carryout redline drawings marking	Identify redline drawings Carryout redline drawings marking	
General Objective 4.0: Understand how to draw diagrams using dedicated Computer Aided Design (CAD) software.						
11–14	3.1 Explain CAD 3.2 Explain how to use CAD in creating electrical and electronic drawing 3.3 Explain the common software used for electrical and electronic drawings: • AutoCAD • EPlan • PC Schematic • Circuit maker 2000, etc.	Explain CAD Explain how to use CAD in creating electrical and electronic drawing Explain the common software used for electrical and electronic drawings: • AutoCAD • EPlan • PC Schematic • Circuit maker 2000, etc.	Textbooks Journals Whiteboard Marker Computer Projector	Use computer software to draw electrical installation diagrams Draw machine diagrams using computer software Draw electronic circuit diagrams using computer software	Guide students to: Use computer software to draw electrical installation diagrams Draw machine diagrams using computer software Draw electronic circuit diagrams using computer software	Computers AutoCAD Electronic Workbench EPlan Circuit maker 2000 PC Schematic Sample drawings
	ASSESSMENT: The Practical class will be awarded 60% of the total score. The continuous assessments, tests and quizzes will take 10% of the total score, while the remaining 30% will be for the end of semester examination score.					

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Introduction to Digital Electronics

PROGRAMME: NATIONAL DIPLOMA ELECTRICAL AND ELECTRONICS ENGINEERING TECHNOLOGY		
COURSE TITLE: Introduction to Digital Electronics	**COURSE CODE:** EEC 112	**CONTACT HOURS:** 3
	CREDIT UNIT: 3	**THEORETICAL:** 2
YEAR: I **SEMESTER:** I	**PRE-REQUISITE:**	**PRACTICAL:** 1
GOAL: This course is designed to equip student with the knowledge and skills of digital electronics system		
GENERAL OBJECTIVES: On completion of this course, the students should be able to: 1.0 Know the basic concept of Number System 2.0 Understand Logic Gates 3.0 Know Logic Simplification and its Applications 4.0 Know Multiplexers and De-Multiplexers 5.0 Understand Latches, flip-flops, and Counters 6.0 Understand Microcontrollers and Programming		

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PROGRAMME: NATIONAL DIPLOMA ELECTRICAL AND ELECTRONICS ENGINEERING TECHNOLOGY					
COURSE TITLE: Introduction to Digital Electronics		**COURSE CODE:** EEC 112		**CONTACT HOURS:** 3	
		CREDIT UNIT: 3		**THEORETICAL:** 2	
YEAR: I **SEMESTER:** I		**PRE-REQUISITE:**		**PRACTICAL:** 1	
COURSE SPECIFICATION: THEORETICAL AND PRACTICAL					
GOAL: This course is designed to equip student with the knowledge and skills of digital electronics system					
General Objective 1.0: Know the basic concept of Number System					
THEORETICAL CONTENT				PRACTICAL CONTENT	
Week	Specific Learning Outcome	Teacher's Activities	Resources	Specific Learning Outcome	Teacher's Activities	Resources
1-3	1.1 Explain analog and digital signals 1.2 Explain applications of digital and analog signals. 1.3 Explain the advantages of analog and digital signals. 1.4 Explain binary, octal, and hexadecimal number system 1.5 Explain conversion from decimal and hexadecimal to binary and vice-versa.	Explain analog and digital signals Explain applications of digital and analog signals. Explain the advantages of analog and digital signals Explain binary, octal, and hexadecimal number system Explain conversion from decimal and hexadecimal to binary and vice-versa.	Textbooks Journals Charts Animations Computer Projector Marker Marker Board	Demonstrate conversion from decimal and hexadecimal	Guide students to: Demonstrate conversion from decimal and hexadecimal	Digital Logic Trainers DMM. Bench Power Supply. Function Generator. Breadboard. Oscilloscope.

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	1.6 Explain binary addition and subtraction 1.7 Explain the addition/subtraction of 1's and 2's complement	Explain binary addition and subtraction, Explain the addition/subtraction of 1's and 2's complement				
General Objective 2.0: Understand Logic Gates						
4-6	2.1 Explain logic gate 2.2 Explain the basic concept of negative and positive logic, 2.3 Define truth table. 2.4 Explain the symbols and truth tables of NOT, AND, OR, NAND, NOR, EXOR Gates 2.5 Describe the NAND and NOR as universal gates. 2.6 Explain interpretation truth tables for logic gates 2.7 Describe the integrated circuit logic	Explain logic gate Explain the basic concept of negative and positive logic, Explain truth table. Explain the symbols and truth tables of NOT, AND, OR, NAND, NOR, EXOR Gates Explain the NAND and NOR as universal gates. Explain interpretation truth tables for logic gates Explain the integrated circuit logic	Textbooks Journals Computer Internet Projector Marker Marker Board	Investigate the logical behavior of AND, OR, NOT, NAND, NOR, and EX-OR gates. Show the NAND gate as a Universal Gate Interpret truth tables for logic gates	Guide Students to: Investigate the logical behavior of AND, OR, NOT, NAND, NOR, and EX-OR gates. Demonstrate and show the NAND gate as a Universal Gate Interpret truth tables for logic gates	Digital Logic Trainer. Logic gates. DMM. Bench Power Supply. Digital Logic Trainer. Function Generator. Breadboard. Oscilloscope.

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	2.8 Explain the concept of integrated circuit Logic families. 2.9 Explain the TTL and CMOS logic families	Explain the concept of integrated circuit Logic families. Explain the TTL and CMOS logic families				
General Objective 3.0: Know Logic Simplification and its Applications						
7-8	3.1 Explain the concept of Boolean algebra 3.2 Explain the implementation of the Boolean (logic) equation with gates 3.3 Explain Karnaugh map up to 4 variables 3.4 Explain the simplicity of Karnaugh map application in developing combinational logic circuits 3.5 Explain the half-adder and full-adder circuit 3.6 Explain the half and full subtractor circuit.	Explain the concept of Boolean algebra Explain the implementation of the Boolean (logic) equation with gates Explain Karnaugh map up to 4 variables Explain the simplicity of Karnaugh map application in developing combinational logic circuits Explain the half-adder and full-adder circuit Explain the half and full subtractor circuit.	Textbooks Journals Computer Internet Projector Marker Marker Board	Verify Boolean Laws using the various logic gates Construct the truth table of various logic gates and combination circuits using logic gates. Evaluate various combinational circuits such as adders, subtractors, Design and implement adders and subtractors using logic gates Implement adders and subtractors using logic gates	Guide the students to: Verify Boolean Laws using the various logic gates Construct the truth table of various logic gates and combination circuits using logic gates. Design, test, and evaluate various combinational circuits such as adders, subtractors, Design and implementation of adders and subtractors using logic gates	Digital Logic Trainer. Logic gates. DMM. Bench Power Supply. Function Generator Breadboard. Oscilloscope.

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	3.7 Explain the design and implementation of half and full subtractor circuits using the Karnaugh map 3.8 Explain the design and implementation of half and full subtractor circuits using the Karnaugh map	Explain the design and implementation of half and full subtractor circuits using the Karnaugh map Explain the design and implementation of half and full subtractor circuits using the Karnaugh map		Design and implement of 4-bit binary adder/subtractor and BCD adder using digital ICs Implement of 4-bit binary adder/subtractor and BCD adder using digital ICs	Design and implementation of 4-bit binary adder/subtractor and BCD adder using digital ICs	
General Objective 4.0: Know Multiplexers and De-Multiplexers						
9-11	4.1 Explain multiplexers and de-multiplexers 4.2 Explain the basic functions and block diagram of multiplexers and de-multiplexers 4.3 Explain the different types and IC configurations. 4.4 Explain interpretation of truth tables for multiplexers and de-multiplexers	Explain multiplexers and de-multiplexers Explain the basic functions and block diagram of multiplexers and de-multiplexers Explain the different types and IC configurations. Explain interpretation of truth tables for multiplexers and de-multiplexers	Textbooks Journals Computer Internet Projector Marker Marker Board	Interpret truth tables for multiplexers and de-multiplexers Implement multiplexer and demultiplexer using logic gate Design multiplexer and demultiplexer using logic gates and study of IC 74150 and IC 74154	Guide the students to: Interpret truth tables for multiplexers and de-multiplexers Implement multiplexer and demultiplexer using logic gate Design multiplexer and demultiplexer using logic gates and study of IC 74150 and IC 74154	Digital Logic Trainer. Logic gates. DMM. Bench Power Supply. Function Generator Breadboard. Oscilloscope

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General Objective 5.0: Understand Latches, flip-flops, and Counters						
12-13	5.1 Describe the concept of the latch and flip-flop 5.2 Explain the difference between a latch and a flip-flop 5.3 Explain the working principle of latch 5.4 Explain the types of latches 5.5 Explain the applications of latches 5.6 Describe the circuit structure of different flip flops and their applications 5.7 Explain the operation of T, D, and Master/Slave JK flip flops using waveforms and truth tables. 5.8 Explain the basic concept of counters 5.9 Explain the following	Explain the concept of the latch and flip-flop Explain the difference between a latch and a flip-flop Explain the working principle of latch Explain the types of latches Explain the applications of latches Explain the circuit structure of different flip flops and their applications Explain the operation of T, D, and Master/Slave JK flip flops using waveforms and truth tables. Explain the basic concept of counters Explain the following	Textbooks Journals Computer Internet Projector Marker Marker Board	Evaluate flip-flops, counters, and shift registers. Implement SISO, SIPO, PISO, and PIPO shift registers using flip-flops. Verify of 4-bit ripple counter and Mod-10, Mod-12, and Mod-N ripple counters Simulate various combinational circuits, sequential circuits flip-flops, and counters. using relevant software Interpret Truth Tables for latches, flip flops, and counters	Guide students to: Construct, test, and evaluate flip-flops, counters, and shift registers. Implement SISO, SIPO, PISO, and PIPO shift registers using flip-flops. Construct, test, and verify of 4-bit ripple counter and Mod-10, Mod-12, and Mod-N ripple counters Simulate various combinational circuits, sequential circuits flip-flops, and counters. using relevant software Interpret Truth Tables for latches, flip flops, and counters	Digital Logic Trainer. IC TRAINER kit Bench Power Supply Logic Gates, Oscilloscope Connecting Probes Logic gates. DMM. Bench Power Supply. Function Generator Breadboard. Oscilloscope

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	counters: • asynchronous and synchronous counters • Binary counters • Divide by N ripple counters • Decade counter • Timers • Shift registers 5.10 Explain how to interpret truth tables for latches, flip flops, and counters	counters: • asynchronous and synchronous counters • Binary counters • Divide by N ripple counters • Decade counter • Timers • Shift registers Explain how to interpret truth tables for latches, flip flops, and counters				
General Objective 6.0: Understand Microcontrollers and Programming						
14-15	6.1 Explain the Concept Microcontrollers. 6.2 Explain the Architecture of the following Microcontrollers; • Arduino Uno • Rasbery Pi • ATMEGAS and • PIC 6.3 Define Microcontroller Programming	Explain the Concept Microcontrollers. Explain the Architecture of the following Microcontrollers; • Arduino Uno • Rasbery Pi • ATMEGAS and • PIC Explain Microcontroller Programming	Textbooks Journals Computer Internet Projector Marker Marker-Board	Identify the Microcontrollers. Identify Microcontroller Input/Output ports, power pins, reset and clock pins. Perform Basic Programming. Load the program from PC to microcontroller	Guide the students to: Identify the Microcontrollers. Identify Microcontroller Input/Output ports, power pins, reset and clock pins. Perform Basic Programming. Load the program from PC to	Computer Arduino Uno kits Rasbery Pi Microcontroller Trainer. IC Programmer. Bench Power supply. Breadboard.

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	6.4 Explain Microcontroller Programming • Instruction set • Programming Language • C++ • Python 6.5 Explain how to interface with microcontrollers and sensors 6.6 Explain how to interface microcontrollers with ADC, DAC, or other microcontrollers	Explain Microcontroller Programming • Instruction set • Programming Language • C++ • Python Explain how to interface with microcontrollers and sensors Explain how to interface microcontrollers with ADC, DAC, or other microcontrollers		via programmer. Setup the hardware (vero board, breadboard, microcontroller, led, sensors, e.t.c) Interface microcontrollers with sensors.	microcontroller via programmer. Setup the hardware (vero board, breadboard, microcontroller, led, sensors, e.t.c) Interface microcontrollers with sensors.	Vero Board. Serial Cable. Sensors. Soldering kits. Computer with appropriate software

EVALUATION: CA 60% EXAMINATION: 40%

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Technical Documentation and Report Writing

PROGRAMME: NATIONAL DIPLOMA ELECTRICAL AND ELECTRONIC ENGINEERING TECHNOLOGY		
COURSE TITLE: Technical Documentation and Report Writing	**COURSE CODE:** EEC 113	**CONTACT HOURS:** 4
	CREDIT UNIT: 3	**THEORETICAL:** 1
YEAR: I **SEMESTER:** I	**PRE-REQUISITE:**	**PRACTICAL:** 3
GOAL: This course is designed to equip students with the knowledge and skills in writing professional, and effective technical documentation and reports.		
GENERAL OBJECTIVES: On completion of this course, the students should be able to: 1.0 Understand the principles of technical communication. 2.0 Know tools and software for creating and editing technical documents. 3.0 Understand the structure and formatting of technical documentation. 4.0 Know professional technical report writing. 5.0 Understand logbooks, work reports, risk assessments and method statements. 6.0 Create project documentation.		

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PROGRAMME: NATIONAL DIPLOMA ELECTRICAL AND ELECTRONIC ENGINEERING TECHNOLOGY					
COURSE TITLE: Technical Documentation and Report Writing			**COURSE CODE:** EEC 113	**CONTACT HOURS:** 4	
			CREDIT UNIT: 3	**THEORETICAL:** 1	
YEAR: I **SEMESTER:** I			**PRE-REQUISITE:**	**PRACTICAL:** 3	
COURSE SPECIFICATION: THEORETICAL AND PRACTICAL					
GOAL: This course is designed to equip students with the knowledge and skills in writing professional, and effective technical documentation and reports.					
General Objective 1.0: Understand the principles of technical communication					
THEORETICAL CONTENT				PRACTICAL CONTENT	
Week	Specific Learning Outcome	Teacher's Activities	Resources	Specific Learning Outcome	Teacher's Activities	Resources
1	1.1 Define technical documentation 1.2 Explain the importance of technical documentation. 1.3 Define general purpose writing 1.4 Explain differences between technical and general-purpose writing. 1.5 Explain types of technical documents in engineering:	Explain technical documentation Explain the importance of technical documentation. Explain general purpose writing Explain differences between technical and general-purpose writing. Explain types of technical documents in engineering: • Datasheets	Textbooks Journals White Board Markers Projector Computer Internet	Identify types of technical documentation	Guide students to: Identify types of technical documentation	Sample Technical documentation Sample reports Sample datasheets

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	• Datasheets • Manuals • Project reports • Project documentation, • Risk assessments • Method statements. 1.6 Explain principles of: • Clarity • Conciseness • Coherence. 1.7 Explain audience analysis 1.8 . Explain the importance of audience analysis.	• Manuals • Project reports • Project documentation, • Risk assessments • Method statements. Explain principles of: • Clarity • Conciseness • Coherence. Explain audience analysis Explain the importance of audience analysis				
General Objective 2.0: Know tools and software for creating and editing technical documents.						
2-4	2.1 Explain tools/software for creating and editing technical documentation: • Microsoft Office • OpenOffice • LaTeX • PDF editors. 2.2 Explain tools/software	Explain tools/software for creating and editing technical documentation: • Microsoft Office • OpenOffice • LaTeX • PDF editors. Explain tools/software for	Textbooks Journals White Board Markers Projector Computer Internet	Operate text editors: • Microsoft Word, • LaTeX. Prepare simple drawings, diagrams using AutoCAD.	Guide students to: Operate text editors: • Microsoft Word, • LaTeX. Prepare simple drawings, diagrams using AutoCAD.	Computer with appropriate software.

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	for diagramming and technical drawings: • AutoCAD • BricsCAD • Matlab visualization, • Microsoft Visio • Microsoft Excel • Microsoft PowerPoint 2.3 Explain collaborative platforms for document creation and editing – teamwork and remote cooperation: • Google Docs • Microsoft 365 • Overleaf.	diagramming and technical drawings: • AutoCAD • BricsCAD • Matlab visualization • Microsoft Visio • Microsoft Excel • Microsoft PowerPoint Explain collaborative platforms for document creation and editing – teamwork and remote cooperation: • Google Docs • Microsoft 365 • Overleaf.		Conduct simple calculations and prepare graphs using Microsoft Excel. Use collaborative platform. • Google Docs.	Conduct simple calculations and prepare graphs using Microsoft Excel. Use collaborative platform. Google Docs	
General Objective 3.0: Understand the structure and formatting of technical documentation.						
5-7	3.1 Explain general structure for documents, reports: • Title • List of changes • Objectives • Background Information – • Theory, • Components, • Equipment,	Explain general structure for documents, reports • Title • List of changes • Objectives • Background Information – • Theory, • Components, • Equipment,	Textbooks Journals White Board Markers Projector Computer Internet	Prepare project proposal including its specific sections: • Client requirements • Specification • Proposed drawings • Bill of materials	Guide students to: Prepare project proposal including its specific sections: • Client requirements • Specification • Proposed drawings • Bill of materials	Sample project proposal

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	• Procedures, • Schematic diagram(s), • Result Analysis, • Answers to questions, • Summary, • Content List (for Tables, Graphs, Diagrams, etc.) • Appendices. 3.2 Explain how to write project proposal including its specific sections: • Client requirements • Specification • Proposed drawings • Bill of materials • Material and labour cost estimation • Execution period 3.3 Explain text formatting and arrangements on page. 3.4 Explain page structure. 3.5 Explain how to use styles	• Procedures, • Schematic diagram(s), • Result Analysis, • Answers to questions, • Summary, • Content List (for Tables, Graphs, Diagrams, etc.) • Appendices. Explain how to write project proposal including its specific sections: • Client requirements • Specification • Proposed drawings • Bill of materials • Material and labour cost estimation • Execution period Explain text formatting, and arrangements on page. Explain page structure. Explain how to use styles		• Material and labour cost estimation • Execution period	• Material and labour cost estimation • Execution period	

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	to format text and paragraphs. 3.6 Explain usage of tables, drawings, math equations.	to format text and paragraphs. Explain usage of tables, drawings, math equations.				
General Objective 4.0: Know professional technical report writing.						
8-9	4.1 Explain the purpose of each of the following sections of a project report: • Cover page • Title page • Approval page • Declaration page • Table of contents • Acknowledgements • Abstract/Summary • List of Symbols and Abbreviation • List of Tables • List of Figures • Body of the project report, divided into chapters • References • Appendices.	Explain the purpose of each of the following sections of a project report: • Cover page • Title page • Approval page • Declaration page • Table of contents • Acknowledgements • Abstract/Summary • List of Symbols and Abbreviation • List of Tables • List of Figures • Body of the project report, divided into chapters • References • Appendices.	Textbooks Journals White Board Markers Projector Computer Internet	Write a project report based on list of project sections. Identify mistakes in technical report and correct them. Identify guidelines for document calculations. Identify guidelines for graphs and numerical data preparation and representation.	Guide students to: Write a project report based on list of project sections. Identify mistakes in technical writing and correct them. Identify guidelines for document calculations. Identify guidelines for graphs and numerical data preparation and representation.	Sample project report Sample technical report

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	4.2 Explain technical writing style guidelines: • Writing objective and factual content. • Using engineering-specific terminologies effectively. • Ensuring grammatical correctness and consistency in style. 4.3 Explain common mistakes in technical writing and how to avoid them. 4.4 Explain guidelines for document calculations. 4.5 Explain guidelines for graphs and numerical data preparation and representation.	Explain technical writing style guidelines: • Writing objective and factual content. • Using engineering-specific terminologies effectively. • Ensuring grammatical correctness and consistency in style. Explain common mistakes in technical writing and how to avoid them. Explain guidelines for document calculations. Explain guidelines for graphs and numerical data preparation and representation.				
General Objective 5.0: Understand logbooks, work reports, risk assessments and method statements.						
10-13	5.1 Define Logbook 5.2 Explain risk assessment	Explain Logbook Explain risk assessment	Textbooks Journals White Board	Fill a Logbook based on work carried out.	Guide students to Fill a Logbook based on work carried out.	Assessment charts

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	5.3 Explain how to fill a Logbook based on work carried out. 5.4 Explain how to write laboratory experiment report. 5.5 Explain the purpose of non-technical report writing: • Background information on project • Progress report • New Development • Response to correspondence • Recommendation 5.6 Explain the purpose for Risk Assessment (RA). 5.7 Explain how to prepare Risk Assessment. 5.8 Explain method statement 5.9 Explain the purpose for Method Statement (MS).	Explain how to fill a Logbook based on work carried out. Explain how to write laboratory experiment report. Explain the purpose of non-technical report writing: • Background information on project • Progress report • New Development • Response to correspondence • Recommendation Explain the purpose for Risk Assessment (RA). Explain how to prepare Risk Assessment. Explain method statement Explain the purpose for Method Statement (MS).	Markers Projector Computer Internet	Write a laboratory experiment report. Write a non-technical report for: • Progress report • New Development • Recommendation Prepare complete RAMS document.	Write a laboratory experiment report. Write a non-technical report for: • Progress report • New Development • Recommendation Prepare complete RAMS document	Sample RAMS.

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	5.10 Explain how to prepare Method Statement. 5.11 Explain reasons for RAMS preparation.	Explain how to prepare Method Statement. Explain reasons for RAMS preparation.				
General Objective 6.0: Create project documentation.						
14-15	6.1 Explain meaning of international standards (ISO, IEEE). 6.2 Explain purpose for regulatory compliance documentation. 6.3 Explain how to write quality assurance reports.	Explain meaning of international standards (ISO, IEEE). Explain purpose for regulatory compliance documentation. Explain writing quality assurance reports.	Textbooks Journals White Board Markers Projector Computer Internet International standards	Prepare of a comprehensive technical project related to hypothetical or real-world scenarios in Electrical and Electronics Engineering - individual or group projects. Present the projects to the class for Peer and teacher evaluation based on clarity, accuracy, and professionalism.	Guide students to: Prepare of a comprehensive technical project related to hypothetical or real-world scenarios in Electrical and Electronics Engineering - individual or group projects. Present the projects to the class for Peer and teacher evaluation based on clarity, accuracy, and professionalism.	Sample Technical report

EVALUATION: CA: 70%

EXAMINATION: 30%

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Electrical Engineering Science I

PROGRAMME: NATIONAL DIPLOMA IN ELECTRICAL AND ELECTRONICS ENGINEERING TECHNOLOGY		
COURSE TITLE: Electrical Engineering Science I	**CODE:** EEC 114	**CONTACT HOURS:** 3
	CREDIT UNIT: 3	**THEORETICAL:** 1
YEAR: I **SEMESTER:** I	**PRE-REQUISITE:**	**PRACTICAL:** 2
GOAL: This course is designed to equip student with knowledge of how electric current flows, the relationships between various types of energy and their behaviours in resistive and capacitive systems.		
GENERAL OBJECTIVES: On completion of this course, the students should be able to: 1.0 Understand the concept of the electric current flow. 2.0 Understand simple DC circuits. 3.0 Understand types of energy and their inter-relationships. 4.0 Understand the concept of electrostatics, electric charge and capacitance of a capacitor.		

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PROGRAMME: NATIONAL DIPLOMA IN IN ELECTRICAL AND ELECTRONICS ENGINEERING TECHNOLOGY			
COURSE TITLE: Electrical Engineering Science I		**CODE:** EEC 114	**CONTACT HOURS:** 3
		CREDIT UNIT: 3	**THEORETICAL:** 1
YEAR: I **SEMESTER:** I		**PRE-REQUISITE:**	**PRACTICAL:** 2
COURSE SPECIFICATION: THEARETICAL AND PRACTICAL CONTENT			
GOAL: This course is designed to equip student with knowledge of how electric current flows, the relationships between various types of energy and their behaviours in resistive and capacitive systems.			
General Objective 1.0: Understand the concept of the electric current flow.			

THEORETICAL CONTENT				**PRACTICAL CONTENT**		
Week	Specific Learning Outcome	Teachers' Activities	Resources	Specific Learning Outcome	Teachers' Activities	Resources
1 – 2	1.1 Define an atom 1.2 Explain with aid of diagram, the structure and composition of an atom 1.3 Explain the concepts of conventional current flow and electron flow. 1.4 Differentiate between conductors, insulators and semi-conductors. 1.5 Define electric current	Explain atomic Explain with aid of diagram, the structure and composition of an atom. Explain the concepts of conventional current flow and electron flow. Explain the differences between conductors, insulators and semi-conductors. Explain electric current	Textbooks Journals White board Marker, Computer Charts Animations Projector.	Determine the effect of variable EMF on single loop DC circuit. Measure current and voltage of power source in a simple circuit using a multimeter	Guide students to: Determine the effect of variable EMF on single loop DC circuit. Measure current and voltage of power source in a simple circuit using a multimeter	Resistor Voltmeter Ammeter Ohmmeter Cables Power source EMF source Multimeter Bulb.

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	1.6 Explain potential difference (PD) and electromotive force (EMF), their units and symbols 1.7 Explain resistance, its units and symbols 1.8 Explain multiples and sub-multiples of electric quantities; (e.g. Mega 10^6, kilo-10^3, etc.)	Explain potential difference (PD) and electromotive force (EMF), their units and symbols Explain resistance, its units and symbols Explain multiples and sub-multiples of electric quantities; (e.g. Mega 10^6, kilo-10^3, etc.)				Video clips
General Objective 2.0: Understand simple D.C. circuits.						
3-6	2.1 Define direct current (DC). 2.2 State the analogy between current flow and water flow. 2.3 Describe basic DC circuits with source using diagram. 2.4 Explain Ohm's law 2.5 Explain how to solve	Explain direct current (DC). Explain the analogy between current flow and water flow. Explain the basic DC circuit with source using diagram. Explain Ohm's law. Explain how to solve	Textbooks Journals White board Marker, Computer Charts Animations Projector.	Verify Ohm's law. Demonstrate series and parallel circuits. Verify the effect of varying resistance on current flow in a conductor. Verify the Kirchhoff's Laws with DC circuits.	Guide students to: Verify Ohm's law. Demonstrate series and parallel circuits. Verify the effect of varying resistance on current flow in a conductor. Verify the Kirchhoff's Laws with DC circuits.	Resistor Voltmeter Ammeter Ohmmeter Cable EMF sources Thermomete

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	problems using Ohm's law. 2.6 Define resistivity and conductivity of a conductor. 2.7 Explain the relationship between resistance of a conductor, its resistivity, length and area. 2.8 Differentiate between series and parallel circuits. 2.9 Explain how to solve problems involving resistivity and conductivity 2.10 Deduce the equivalent resistance of series and parallel circuits. 2.11 Explain Kirchhoff's Laws (KCL, KVL).	problems using Ohm's law. Explain resistivity and conductivity of a conductor. Explain the relationship between resistance of a conductor, its resistivity, length and area. Explain the differences between series and parallel circuits. Explain how to solve problems involving resistivity and conductivity Explain the equivalent resistance of series and parallel circuits. Explain Kirchhoff's Laws (KCL, KVL).		Verify superposition principle. Determine the temperature coefficient of a resistance Verify the heating effect.	Verify superposition principle. Determine the temperature coefficient of a resistance Verify the heating effect.	r Electronic trainer Video clips

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	2.12 Explain the Superposition Principle. 2.13 Explain how to solve problems involving series and parallel circuits using Kirchhoff's Laws and superposition principles. 2.14 Define temperature coefficient of resistance. 2.15 Use the expression for resistance at temperature T°k and calculate change in resistance. 2.16 See from (2.15) the change in resistance due to change in temperature.	Explain the Superposition Principle. Explain how to solve problems involving series and parallel circuits using Kirchhoff's Laws and superposition principles Explain temperature coefficient of resistance. Use the expression for resistance at temperature T°k and calculate change in resistance. See from (2.15) the change in resistance due to change in temperature. Explain how to solve problems involving effect of temperature on resistance.				

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	2.17 Explain how to solve problems involving effect of temperature on resistance.					
General Objective: 3.0 Understand types of energy and their inter-relationships						
10– 12	3.1 Define energy 3.2 Explain types of energy. 3.3 Explain the sources of energy 3.4 Explain the relationship between electrical, mechanical and thermal energy 3.4 State units of energy in (3.2) 3.4 State Joule's law. 3.5 Solve problems involving Joule's law.	Explain energy Explain types of energy. Explain the sources of energy Explain the relationship between electrical, mechanical and thermal energy State units types of energy in (3.2) State Joule's law. Solve problems involving Joule's law.	Textbooks Journals White board Marker Computer Internet Charts Animations Projector.	Perform experiment to determine the DC power.	Guide students to Perform experiment to determine the DC power.	Resistor Voltmeter Ammeter Ohmmeter Cable EMF sources

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General Objective: 4.0 Understand the concept of electrostatics, electric charge and capacitance of a capacitor.						
11-14 **15**	4.1 Explain electric charge and state its unit. 4.2 State Coulomb's law 4.3 Explain how to solve problems involving coulomb's law. 4.4 Explain: • Electric field strength • Electric flux density • Permittivity • Relative permittivity • Field intensity • Potential difference • Electric flux 4.5 Explain how to solve problems involving the terms in (4.4) above. 4.6 Define capacitance. 4.7 Derive an expression for	Explain electric charge and state its unit. State Coulomb's law Explain how to solve problems involving coulomb's law. Explain: • Electric field strength • Electric flux density • Permittivity • Relative permittivity • Field intensity • Potential difference • Electric flux Explain how to solve problems involving the terms in (4.4) above. Explain capacitance.	Textbooks Journals White board Marker Computer Internet Charts Animations Projector.	Verify Coulombs' Law using experiment. Perform experiment on charging and discharging of a capacitor.	Guide students to: Verify Coulombs' Law using experiment. Perform experiment on charging and discharging of a capacitor.	Resistor Capacitor Voltmeter Ammeter Ohmmeter Cable EMF source Electronic trainer

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	the capacitance of parallel plate capacitors in terms of area, the distance between plates and permittivity of the dielectric. 4.8 Derive an expression for the capacitance of a capacitor with composite dielectrics. 4.9 Derive an expression for the voltage distribution between series connected capacitors. 4.10 Deduce an expression for the equivalent capacitance for capacitors connected in series and in parallel. 4.11 Derive an expression for the energy stored in a capacitor.	Explain how to derive an expression for the capacitance of parallel plate capacitors in terms of area, the distance between plates and permittivity of the dielectric. Explain how to derive an expression for the capacitance of a capacitor with composite dielectrics. Explain how to derive an expression for the voltage distribution between series connected capacitors. Explain how to deduce an expression for the equivalent capacitance for capacitors connected in series and in parallel.				

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	4.12 Explain how to solve problems involving (4.8 - 4.11).	Explain how to derive an expression for the energy stored in a capacitor. Explain how to solve problems involving (4.8 - 4.11).				
ASSESSMENT: The practical class will be awarded 60% of the total score. The continuous assessments, test and quizzes will take 10% of the total score, while the remaining 30% will be for the end of the semester examination score.						

NATIONAL BOARD FOR TECHNICAL EDUCATION

PROGRAMME: NATIONAL DIPLOMA IN ELECTRICAL AND ELECTRONICS ENGINEERING TECHNOLOGY		
COURSE TITLE: Industrial Health and Safety	**CODE:** EEC 115	**CONTACT HOURS:** 2
	CREDIT UNIT: 2	**THEORETICAL:** 1
YEAR: I **SEMESTER:** I	**PRE-REQUISITE:**	**PRACTICAL: 1**
GOAL: This course is designed to equip student with knowledge and skills to observe Health and Safety in an Industrial field		
GENERAL OBJECTIVES: On completion of this course, the students should be able to: 1.0 Integrate health and safety procedures into the work environment. 2.0 Relate legislation from the Occupational Health and Safety Act and regulations. 3.0 Know how to deal with hazards. 4.0 Know the methods of control that will reduce exposure to hazards. 5.0 Understand health and safety practices 6.0 Understand the concept of First Aid		

NATIONAL BOARD FOR TECHNICAL EDUCATION

PROGRAMME: NATIONAL DIPLOMA IN IN ELECTRICAL AND ELECTRONICS ENGINEERING TECHNOLOGY						
COURSE TITLE: Industrial Health and Safety			**CODE:** EEC 115		**CONTACT HOURS:** 2	
			CREDIT UNIT: 2		**THEORETICAL:** 1	
YEAR: I **SEMESTER:** I			**PRE-REQUISITE:**		**PRACTICAL: 1**	
COURSE SPECIFICATION: THEARETICAL AND PRACTICAL CONTENT						
GOAL: This course is designed to equip student with knowledge and skills to observe Health and Safety in an Industrial field						
General Objective 1.0: Integrate health and safety procedures into the work environment.						
THEORETICAL CONTENT				**PRACTICAL CONTENT**		
Week	Specific Learning Outcome	Teachers' Activities	Resources	Specific Learning Outcome	Teachers' Activities	Resources
1 – 3	1.1 Explain accidents 1.2 Explain injury 1.3 Define health and safety 1.4 Differentiate between health and safety 1.5 Explain the importance of health and safety. 1.6 Differentiate between accidents and injury 1.7 Explain the functions of the Health Safety (HSE) Officer 1.8 Describe the elements	Explain between accidents and injury Explain health and safety Explain the differences between health and safety Explain the importance of health and safety. Explain the differences between accidents and injury Explain the functions of the Health Safety (HSE) Officer	Textbook Journals Marker, Whiteboard, Projector, Computer health and safety policy Government regulations,	Identify different types of safety signs. Identify and document workplace hazards in a real or simulated environment. Perform risk assessments and recommend control strategies. Select, use, and maintain correct PPE for specific tasks. Select and install appropriate signage according to location-specific hazards.	Guide learners on a site inspection to identify hazards. Supervise learners as they carry out a risk assessment on a workstation or task. Demonstrate how to inspect, wear, and maintain PPE. Supervise student practice	Checklist templates Risk assessment forms Helmets, gloves, masks, safety glasses Fire alarm, extinguisher

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	of a successful health and safety programme 1.9 Explain the causes of accidents and injuries 1.10 Describe the major items on a safety policy 1.11 Explain accident reporting and the preparation of an accident report 1.12 Explain the safety audit process 1.13 Explain sampling and monitoring 1.14 Explain risk identification and assessment process.	Explain the elements of a successful health and safety programme Explain the causes of accidents and injuries Explain the major items on a safety policy Explain accident reporting and the preparation of an accident Report Explain the safety audit process Explain sampling and monitoring Explain risk identification and assessment process.		.		, evacuation plan Safety sign materials, tape, wall surface Incident report forms, role-play scenarios
General Objective 2.0: Relate legislation from the Occupational Health and Safety Act and regulations						
4-6	2.1 Explain the basic rights of workers under the Occupational Safety and Health Administration (OSHA)	Explain the basic rights of workers under the Occupational Safety and Health Administration (OSHA)	Textbook Journals Marker, Whiteboard	Apply relevant legislative requirements to assess workplace compliance.	Guide students to: Apply relevant legislative	compliance checklist template

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	2.2 Explain who is covered and who is not 2.3 Explain the process for the steps to follow under the right to refuse work and the right to stop work 2.4 Explain workplace hazardous materials (industry-specific) • Manufacturing • Construction • Agriculture • Extractive • Energy 2.5 Explain workplace hazardous materials information systems. 2.6 Explain how workplace hazardous materials information is relayed to workers. 2.7 Explain the six categories of controlled substances e.g.	Explain who is covered and who is not Explain the process for the steps to follow under the right to refuse work and the right to stop work Explain workplace hazardous materials (industry-specific) • Manufacturing • Construction • Agriculture • Extractive Explain workplace hazardous materials information systems. Explain how workplace hazardous materials information is relayed to workers. Explain the six categories of controlled substances e.g. Chemical.	Projector, Computer health and safety policy	Interpret key legislative safety signage and documents. Practice legal reporting procedures for unsafe conditions under OHS law.	requirements to assess workplace compliance. Interpret key legislative safety signage and documents. Practice legal reporting procedures for unsafe conditions under OHS law.	Video clips

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	Chemical.					
General Objective 3.0: Understand how to deal with hazards.						
7– 8	3.1 Explain the steps to deal with hazards 3.2 Describe the factors to determine the degree of hazard 3.3 Differentiate between the terms; • Hazardous and toxic • Acute and chronic 3.4 Explain the terms related to health hazards 3.5 Explain the types of hazards 3.6 Describe noise production, measurement, and control 3.7 Explain how to protect the worker from noise hazards 3.8 Explain how to protect the worker from heat	Explain the steps to deal with hazards Explain the factors to determine the degree of hazard Explain the terms; • Hazardous and toxic • Acute and chronic Explain the terms related to health hazards Explain the types of hazards Describe noise production, measurement, and control Explain how to protect the worker from noise hazards	Textbook Journals Marker, Whiteboard , Projector, Computer health and safety policy	Identify and record hazards in a work environment. Conduct a basic risk assessment and suggest control measures. Apply appropriate hazard control methods using the hierarchy of controls. Report on hazards to supervisors or safety reps.	Guide students to: Identify and record hazards in a work environment. Conduct a basic risk assessment and suggest control measures. • Apply appropriate hazard control methods using the hierarchy of controls. Report on hazards to supervisors or safety reps.	Hazard spotting checklist PPE instruction posters Floor plan templates, colored markers, legend guides Incident reports, analysis templates

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	stress and cold stress.	Explain how to protect the worker from heat stress and cold stress.				
General Objective 4.0: Know the methods of control that will reduce exposure to hazards						
9-11	4.1 Define general ventilation and exhaust systems to maintain safe work environments 4.2 Describe work practices and controls that can reduce exposure levels 4.3 Describe qualitative and quantitative respirator systems 4.4 Explain different protective devices to minimize exposure to hazards 4.5 Explain power outage and isolation systems Explain Lock-Out Tag-Out and Try-Out	Explain general ventilation and exhaust systems to maintain safe work environments Explain work practices and controls that can reduce exposure levels Explain qualitative and quantitative respirator systems Explain different protective devices to minimize exposure to hazards Explain lock-out and isolation systems Explain Lock-Out Tag-Out and Try-Out (LOTOTO) systems	Textbook Journals Marker, Whiteboard , Projector, Computer health and safety policy	Identify control measures in place and assess their adequacy and effectiveness. Apply the hierarchy of control to select appropriate measures for specific hazards.	Guide students to: Identify control measures in place and assess their adequacy and effectiveness. Apply the hierarchy of control to select appropriate measures for specific hazards.	Video clips Emergency procedure charts, sample evacuation maps.

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	(LOTOTO) systems					
General Objective 5.0: Understand health and safety practices						
12-13	5.1 Explain safety and health requirements. 5.2 Explain Safety signs and symbols. 5.3 Describe the importance of using personal protective equipment (PPE) 5.4 Explain PPE related procedures 5.5 Explain the safety principles for working on and around electrical equipment; • Effects of electric current on the human body. • Factors that affect the severity of an electric shock. • The effects of arc and blast on the human body and equipment. • Working with	Explain safety and health requirements. Explain Safety signs and symbols. Explain Safety signs and symbols. Explain PPE related procedures Explain the safety principles for working on and around electrical equipment; • Effects of electric current on the human body. • Factors that affect the severity of an electric shock. • The effects of arc and blast on the human body and equipment.	Textbook Journals Marker, Whiteboard , Projector, Computer health and safety policy	Identify safety and health requirements. Identify Safety signs and symbols. Demonstrate the use of PPE • Safety boots • Helmets • Goggle • Face Shield • Coverall • Earmuff • Harness • Nose Mask • Hand glove Organize a simulated fire drill. Debrief students post-exercise. Demonstrate safe manual	Guide students to: Identify safety and health requirements. Identify Safety signs and symbols. Demonstrate the use of PPE • Safety boots • Helmets • Goggle • Face Sheild • Coverall • Earmuff • Harness • Nose Mask • Hand glove Organize a simulated fire drill. Debrief students post-exercise. Demonstrate safe manual handling or	Safety Charts Safety boots Helmets Goggle Coverall Earmuff Harness Nose Mask Hand glove Evacuation maps, alarms, stopwatch Safety equipment, load lifting aids,

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	energized equipment. 5.6 Explain fire safety principles in the workplace. 5.7 Explain hazards in confined spaces and the preparation needed to work in a confined space. 5.8 Explain how to protect the worker and others when working in traffic paths (walkways) 5.9 Explain safety measures related to walkways, stairs, and floor openings 5.10 Explain the importance of industrial housekeeping by applying (5S) Total Productive Management (TPM) methodology • Sort	• Working with energized equipment. Explain fire safety principles in the workplace. Explain hazards in confined spaces and the preparation needed to work in a confined space. Explain how to protect the worker and others when working in traffic paths (walkways) Explain safety measures related to walkways, stairs, and floor openings Explain the importance of industrial housekeeping by applying (5S) Total Productive Management		handling or machinery use. Conduct role-play of an incident and reporting.	machinery use. Conduct role-play of an incident and reporting.	demonstration items Incident report forms, role cards Cleaning tools, labeling materials

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	• Set • Shine • Standardize and Sustain	(TPM) methodology • Sort • Set • Shine • Standardize and Sustain				
General Objective 6.0 **Understand the concept of First Aid**						
14-15	6.1 Define first aid 6.2 Explain the aims of First Aid 6.3 Explain the essentials of a first aid kit 6.4 Explain the mechanics of injury 6.5 Explain the priorities of treatment 6.6 Explain Resuscitation • Cardiopulmonary Resuscitation (CPR) • Resuscitation for babies and children	Explain first aid Explain the aims of First Aid Explain the essentials of a first aid kit Explain the mechanics of injury Explain the priorities of treatment Explain Resuscitation • Cardiopulmonary Resuscitation (CPR) • Resuscitation for	Textbook Journals Marker, Whiteboard, Projector, Computer health and safety policy	Perform first aid Carry out CPR Identify and use first aid materials and tools. Apply appropriate procedures for treating minor bleeding and wounds. Immobilize limbs in cases of suspected fractures or sprains. Perform abdominal thrusts for choking victims (adults and children).	Guide students to: Perform first aid and Carry out CPR Supervise handling and identification of kit components. Demonstrate immobilization techniques using splints or slings. Demonstrate and	• Standard first aid box • CPR accessories. • First aid kits, checklists • Gauze, gloves, fake wounds,

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	• Resuscitation with chest compressions only • hygiene during resuscitation 6.7 Explain the main causes of unconsciousness in a casualty 6.8 Explain first aid practices for the following conditions; • Asthma emergencies • Anaphylaxis • Burns • Choking • Fainting • Hyperventilation • Diabetic emergencies • External bleeding and severe trauma • Environmental emergencies • Heart Attack • Poisoning • Neck, head and spinal injuries • Stroke	babies and children • Resuscitation with chest compressions only • hygiene during resuscitation Explain the main causes of unconsciousness in a casualty Explain first aid practices for the following conditions; • Asthma emergencies • Anaphylaxis • Burns • Choking • Fainting • Hyperventilation • Diabetic emergencies • External bleeding and severe trauma • Environmental emergencies • Heart Attack • Poisoning			supervise Heimlich technique on training manikins. Organize mock emergency drills and evaluate student responses.	antiseptic • Splints, bandages, mannequins • Choking manikins, instructional posters. • CPR manikins, AED trainer (if available) • Burn kits, water basins, dressings

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	• Seizure	• Neck, head and spinal injuries • Stroke • Seizure				Simulation space, props, assessment sheets.
ASSESSMENT: The practical class will be awarded 60% of the total score. The continuous assessments, test and quizzes will take 10% of the total score, while the remaining 30% will be for the end of the semester examination score						

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YEAR ONE, SEMESTER TWO

NATIONAL BOARD FOR TECHNICAL EDUCATION

Electrical Power I

PROGRAMME: NATIONAL DIPLOMA IN ELECTRICAL AND ELECTRONICS ENGINEERING TECHNOLOGY		
COURSE TITLE: Electrical Power I	**COURSE CODE:** EEC 121	**CONTACT HOURS:** 3
	CREDIT UNIT: 2	**THEORETICAL:** 1
YEAR: I **SEMESTER:** II	**PRE-REQUISITE:**	**PRACTICAL:** 2
GOAL. This course is designed to acquaint the students with the knowledge and skills of the principles of generation, transmission and distribution of electrical energy to consumers.		
GENERAL OBJECTIVES: On completion of this course the students should be able to: 1.0: Understand the principles of generation and transmission of electrical energy 2.0 Understand the basic principles of distribution systems 3.0 Understand the basic principles of protection in power systems. 4.0: Understand types of insulators and support structures		

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PROGRAMME: NATIONAL DIPLOMA IN ELECTRICAL AND ELECTRONICS ENGINEERING TECHNOLOGY						
COURSE TITLE: Electrical Power I			**COURSE CODE:** EEC 121		**CONTACT HOURS:** 3	
			CREDIT UNIT: 2		**THEORETICAL:** 1	
YEAR: I **SEMESTER:** II			**PRE-REQUISITE:**		**PRACTICAL:** 2	
COURSE SPECIFICATION: THEORETICAL AND PRACTICAL						
GOAL: This course is designed to acquaint the students with the knowledge and skills of the principles of generation, transmission and distribution of electrical energy to consumers.						
General Objective 1.0: Understand the principles of generation and transmission of electrical energy.						
THEORETICAL CONTENT				**PRACTICAL CONTENT**		
Week	**Specific Learning Outcome**	**Teachers' Activities**	**Resources**	**Specific Learning Outcome**	**Teachers' Activities**	**Evaluation**
1 – 3	1.1 Define power plant. 1.2 Explain generation system 1.3 Explain the layout of: • Steam plant • Diesel plant • Gas plant • Hydro power plant • Solar and wind plant 1.4 Explain the general layout for the	Explain power plant. Explain generation system Explain the layout of: • Steam plant • Diesel plant • Gas plant • Hydro power plant • Solar and wind plant Explain the generation, transmission and distribution	Textbooks Journals Whiteboard Marker Charts Animations Computer Projector	Organize Industrial visits to observe the layout of Generation, Transmission and Distribution of power systems. Draw the layout of Steam plant, Diesel plant, Gas plant, Solar and wind plant.	Guide to students: Organize Industrial visits to observe the layout of Generation, Transmission and Distribution of power systems. Draw the layout of Steam plant, Diesel plant, Gas plant, Solar and wind plant.	Drawing materials Transmission and distribution line trainers' short and medium transmission line model Conductors

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	generation transmission and distribution of electrical energy. 1.5 Differentiate between transmission and distribution networks. 1.6 State the voltage levels of generating station, transmission and distribution networks. 1.7 Distinguish between short and medium transmission lines. 1.8 Explain the principles of power protection schemes. 1.9 Explain the types and sizes of conductors used for transmission, distribution and utilization of	of electrical power systems. Explain the differences between transmission and distribution networks. Explain the voltage levels of generating station, transmission and distribution networks. Explain the short and medium transmission lines. Explain the principles of power protection schemes. Discuss the types and sizes of conductors used for transmission, distribution and utilization of electrical power.		Draw the layout of generation, transmission and distribution of electrical power systems. Draw the diagram of generating station, transmission and distribution networks with voltage levels. .	Draw the layout of generation, transmission and distribution of electrical power systems. Draw the diagram of generating station, transmission and distribution networks with voltage levels.	

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	electrical power 1.10 Explain how to determine the short transmission line parameters. 1.11 Explain the construction of underground cables. 1.12 Explain how to solve problems involving short transmission lines.	Explain how to determine the short transmission line parameters. Explain the construction of underground cables. Explain how to solve problems involving short transmission lines.				
General Objective 2.0**:** Understand the basic principles of distribution systems						
7 – 9	2.1 Explain distribution system networks 2.2 Explain the difference between distributors and feeders 2.3 Describe the basic components of distribution systems 2.4 Explain how to solve problems involving	Explain distribution system networks Explain the difference between distributors and feeders Explain the basic components of distribution systems Explain how to solve the problems involving	Textbooks Journals Whiteboard Marker Charts Animations Computer Projector	Identify the basic components of distribution systems Determine balancing situations of connected grid to distribution network to ensure power and load demand are equal via calculation	Guide students to: Identify the basic components of distribution systems Determine balancing situations of connected grid to distribution network to ensure power and load	Distributors Feeders and protection devices. Paper Calculators

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	voltage drops in simple distribution systems. 2.5 Describe the principles of protection in distribution system	voltage drops in distribution systems Explain the principles of protection in distribution system			demand are equal via calculation	
General Objective 3.0: Understand the basic principles of protection in power systems.						
10 -13	3.1 Define a fuse 3.2 Describe the parts of a fuse. 3.3 Explain the purpose of a fuse. 3.4 Define fusing currents, current rating and fusing factor. 3.5 Describe the moulded case circuit breaker. 3.6 Define the interruption capacity of a circuit breaker	Explain a fuse Describe the parts of a fuse. Explain the purpose of a fuse. Explain fusing currents, current rating and fusing factor. Explain the moulded case of a circuit breaker. Explain the interruption capacity of a circuit breaker	Textbooks Journals Whiteboard Marker Charts Animations Computer Projector	Identify the parts a fuse. Demonstrate the function of a fuse. Identify the moulded case circuit breaker. Demonstrate the function of an isolator. Identify the difference between a circuit breaker and an isolator	Guide students to: Identify the parts a fuse. Demonstrate the function of a fuse. Identify the moulded case circuit breaker. Demonstrate the function of an isolator. Identify the difference between a circuit breaker and an isolator	Fuse Isolator Circuit breaker Video clips

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	3.7 Define an isolator. 3.8 Explain the difference between a circuit breaker and an isolator	Explain an isolator. Explain the difference between a circuit breaker and an isolator				
General Objective 4.0: Understand types of insulators and support structures						
14 -15	1.1 Define insulator. 1.2 Describe with the aid of diagrams types of insulators • Post type • Pin type • Shackle ring, etc. 1.3 State the applications of the insulators in 4.2 1.4 Describe types of insulating materials and their applications. 1.5 Describe support structures: • Wooden (Treated) • Concrete Steel (Galvanized)	Explain insulator. Explain with the aid of diagrams types of insulators • Post type • Pin type • Shackle ring, etc. Explain the applications of the insulators in 4.2 Explain types of insulating materials and their applications. Explain support structures: • Wooden (Treated) • Concrete	Textbooks Journals Whiteboard Marker Charts Animations Computer Projector	Identify types of insulators. Demonstrate the applications of insulators in distribution network	Guide students to: Identify types of insulators. Demonstrate the applications of insulators in distribution network	Post type Pin type and shackle ring insulators

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		• Steel (Galvanized)				
ASSESSMENT: The continuous assessment; tests and quizzes will be awarded 60% of the total score. The end of Semester Examination will make up for the remaining 40% of the total score.						

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Electrical Machine I

PROGRAMME: NATIONAL DIPLOMA IN ELECTRICAL AND ELECTRONICS ENGINEERING TECHNOLOGY		
COURSE TITLE: Electrical Machine I	**CODE:** EEC 122	**CONTACT HOURS:** 3
	CREDIT UNIT: 2	**THEORETICAL:** 1
YEAR: I **SEMESTER:** II	**PRE-REQUISITE:**	**PRACTICAL:** 2
GOAL: This course is designed to equip the student with the knowledge and skills of the principles of operations, construction and maintenance of electrical machines		
GENERAL OBJECTIVES: At the end of the course the student should be able to: 1.0 Understand the concept of magnetism 2.0 Understand the basic principle of DC Generator 3.0 Understand the basic principle of DC Motor 4.0 Understand the principle of Single-phase Induction Motor		

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PROGRAMME: NATIONAL DIPLOMA IN ELECTRICAL AND ELECTRONICS ENGINEERING						
COURSE TITLE: Electrical Machine I			**COURSE CODE:** EEC 122		**CONTACT HOURS:** 3	
			CREDIT UNIT: 2		**THEORETICAL:** 1	
YEAR: I **SEMESTER:** II			**PRE-REQUISITE:**		**PRACTICAL:** 2	
COURSE SPECIFICATION: THEORETICAL AND PRACTICAL						
GOAL: This course is designed to equip student with the knowledge of the principles of operations, construction and maintenance of electrical machines						
General Objective 1.0: Understand the concept of magnetism						
THEORETICAL CONTENT				**PRACTICAL CONTENT**		
Week	**Specific Learning Outcome**	**Teachers' Activities**	**Resources**	**Specific Learning Outcome**	**Teachers' Activities**	**Resources**
1	1.1 Explain Magnetism. 1.2 Explain electromagnetic fields 1.3 Explain electromagnetic induction	Explain Magnetism. Explain electromagnetic fields Explain electromagnetic induction	Textbooks Journals Whiteboard Marker Charts Animations Computer Projector	Determine direction of magnetic field.	Guide the student to: Determine direction of magnetic field.	Magnet Iron particles Video clips

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General Objective 2.0**:** Understand the basic principles of DC Generator						
2 – 4	2.1 Explain basic principles of a DC Generator 2.2 Explain construction of a DC Generator 2.3 Describe armature reaction and emf equations. 2.4 Explain classification of generators. 2.5 Describe Voltage regulation 2.6 Explain generator power losses.	Explain basic principles of a DC Generator Explain construction of a DC Generator Describe armature reaction and emf equations. Explain classification of generators. Explain Voltage regulation Explain generator power losses.	Textbooks Journals Whiteboard Marker Charts Animations Computer Projector	Disassemble and assemble a DC Generator. Determine a DC Generator terminal. Determine the characteristics of separately excited DC Generator. Perform an experiment to show the relationship between armature voltage and load current	Guide students to: Disassemble and assemble a DC Generator. Determine a DC Generator terminal. Determine the characteristics of separately excited DC Generator. Perform an experiment to show the relationship between armature voltage and load current	DC generator Separately excited DC generator Voltmeter Ammeter Voltage source
General Objective 3.0: Understand the basic principle of DC Motor						
5 -9	3.1 Explain DC motor 3.2 Describe operational principle of a DC motor 3.3 Explain the construction of DC	Explain DC motor Explain the operational principle of a DC motor Explain the construction of DC	Textbooks Journals Whiteboard Marker Charts Animations Computer	Interpret a Motor name plate Conduct an experiment on DC Shunt motor	Guide the students to: Interpret a Motor name plate Conduct an experiment on DC Shunt motor Characteristics.	DC motor Sample motor name plate Series motor

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	motor. 3.4 State Characteristics of DC Motor. 3.5 Outline starting methods of DC Motor. 3.6 Describe reversal of rotation of a DC motor 3.7 Describe the procedure for the Inspection and maintenance of DC Motors	motor. Explain Characteristics of DC Motor. Explain starting methods of DC Motor. Explain reversal of rotation of a DC motor Explain the procedure for the Inspection and maintenance of DC Motors	Projector	Characteristics. Carry out experiment on DC Series motor Characteristics. Perform an experiment on DC Compound motor Characteristics. Carry out an experiment on starting DC motor using a relay	Carry out experiment on DC Series motor Characteristics. Perform an experiment on DC Compound motor Characteristics. Carry out an experiment on starting DC motor using a relay	Shunt motor Compound motor relay
General Objective 4.0: Understand the basic principles of Single Phase Induction Motor						
10 - 15	3.1 Explain a single phase induction motor 3.2 Describe operational principle of a Single Phase induction motor 3.3 Explain the construction of a	Explain a single phase induction motor Describe operational principle of a Single Phase induction motor Explain the construction of a Single Phase	Textbooks Journals Whiteboard Marker Charts Animations Computer Projector	Perform experiment on the Characteristic of Split phase induction motor. Carry out experiment on Characteristic of Capacitor Start motor and Capacitor	Guide the students to: Perform experiment on the Characteristic of Split phase induction motor. Carry out experiment on Characteristic of Capacitor Start motor	Split phase induction motor Capacitor Start motor, Capacitor run motor

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	Single Phase induction motor 3.4 Describe types of single-phase Induction motor. 3.5 Describe motor speed of asynchronous motor 4.6 Describe power losses and efficiency.	induction motor Explain types of single-phase Induction motor. Explain motor speed of asynchronous motor Explain power losses and efficiency		run motor Inspect and maintain a Motor Perform troubleshooting and repair of AC motors	and Capacitor run motor Inspect and maintain a Motor Perform troubleshooting and repair of AC motors	Single-phase induction motor
ASSESSMENT: Assessment: The practical class will be awarded 60% of the total score. The continuous assessments, tests and quizzes will be 10% the total score, while the remaining 30% will be for the end of semester examination.						

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ELECTRONICS I

PROGRAMME: NATIONAL DIPLOMA IN ELECTRICAL AND ELECTRONICS ENGINEERING TECHNOLOGY		
COURSE TITLE: ELECTRONICS I	**COURSE CODE:** EEC 123	**CONTACT HOURS:** 3
	CREDIT UNIT: 2	**THEORETICAL:** 1
YEAR: I **SEMESTER:** II	**PRE-REQUISITE:**	**PRACTICAL:** 2
GOAL: This course is designed to equip the student with the knowledge and skills of passive and active electronic components and their applications		
GENERAL OBJECTIVES: At the end of the course the student should be able to: 1.0 Understand the concept of passive components 2.0 Understand the concept of active components 3.0 Understand the characteristics of a PN Junction and Zener Diode 4.0 Understand application of Bipolar Junction Transistor 5.0 Understand the basic structure and application of thyristor		

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PROGRAMME: NATIONAL DIPLOMA IN ELECTRICAL AND ELECTRONICS ENGINEERING						
COURSE TITLE: ELECTRONICS I			**COURSE CODE:** EEC 123		**CONTACT HOURS:** 3	
			CREDIT UNIT: 2		**THEORETICAL:** 1	
YEAR: I **SEMESTER:** II			**PRE-REQUISITE:**		**PRACTICAL:** 2	
COURSE SPECIFICATION: THEORETICAL AND PRACTICAL						
GOAL: This course is designed to equip the student with the knowledge and skills of passive and active electronic components and their applications						
General Objective 1.0: Understand the concept of passive components						
THEORETICAL CONTENT				**PRACTICAL CONTENT**		
Week	**Specific Learning Outcome**	**Teachers' Activities**	**Resources**	**Specific Learning Outcome**	**Teachers' Activities**	**Resources**
1-2	1.1 Define matter and basic structure of Atom. 1.2 Define passive electronic components: • Resistors • Capacitors • Inductors 1.3 Explain color codes in accordance with EIA standards 1.4 Explain variable	Explain matter and basic structure of Atom. Explain passive electronic components: • Resistors • Capacitors • Inductors Explain color codes in accordance with EIA standards Explain variable resistor:	Textbook Journal Chart Animations Computer Projector Whiteboard Marker	Construct a simple electronic circuit consisting of two resistors in series as a voltage divider	Guide students to: Construct a simple electronic circuit consisting of two resistors in series as a voltage divider	Breadboard Resistor DC Power source Multimeter

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	resistor: • Potentiometer • Rheostat	• Potentiometer • Rheostat				
General Objective 2.0: Understand the concept of active components						
3 – 4	2.1 Define a semiconductor 2.2 Explain matter and basic structure of Atom. 2.3 Explain electrons and holes as carriers of electric charges. 2.4 Describe energy levels in material, Valence and Conduction 2.5 Describe Conductors, Insulators and Semiconductors. 2.6 Describe Conduction in Metals and Gas. 2.7 Describe the concept of	Define a semiconductor Explain matter and basic structure of Atom. Describe electrons and holes as carriers of electric charges. Describe energy levels in material, Valence and Conduction Describe Conductors, Insulators and Semiconductors. Describe Conduction in Metals and Gas. Describe the concept of doping in semiconductors	Textbook Journal Chart Animations Computer Projector Whiteboard Marker	Identify Semiconductor components with their circuit symbol. Carry out an experiment on breadboard to implement circuit from the schematic diagram. Perform experiment on how to solder and unsolder components on a printed wiring circuit board Demonstrate soldering techniques	Guide students to: Identify Semiconductor components with their circuit symbol. Carry out an experiment on breadboard to implement circuit from the schematic diagram. Perform experiment on how to solder and unsolder components on a printed wiring circuit board Demonstrate soldering techniques	Semiconductor components Breadboard Sample schematic diagram Soldering iron Printed wiring circuit board Power source Soldering Lead Soldering

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	doping in semiconductors 2.8 Explain Intrinsic and Extrinsic Semiconductor	Explain Intrinsic and Extrinsic Semiconductor				paste, Sucker
General Objective 3.0: Understand characteristics of a PN Junction and Zener Diode						
5 -7	3.1 Define a PN junction Diode. 3.2 Define Zener Diode. 3.3 Describe Avalanche Breakdown (Zener diode). 3.4 Describe applications of Semiconductor diode 3.5 Describe Voltage Stabilisation and Reference. 3.6 Describe Voltage Shifting. 3.7 Define transistor	Explain a PN junction Diode. Explain Zener Diode. Explain Avalanche Breakdown (Zener diode). Explain applications of Semiconductor diode Explain Voltage Stabilisation and Reference. Explain Voltage Shifting. Define transistor	Textbook Journal Chart Animations Computer Projector Whiteboard Marker			

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	3.8 Explain the applications of transistor: • Amplification • Switching 3.9 Explain transistor biasing 3.10 Explain transistor saturation and cut-off	Explain the applications of transistor: • Amplification • Switching Explain transistor biasing Explain transistor saturation and cut-off				
General Objective 4.0: Understand the application of Bipolar Junction Transistor						
8 - 11	4.1 Describe the Bipolar Junction Transistor. 4.2 Explain the working principle of Bipolar Junction Transistor using 2 diode model 4.3 Describe Common Emitter Configuration • Voltage gain • Current Gain	Describe the Bipolar Junction Transistor. Explain the working principle of Bipolar Junction Transistor using 2 diode model Explain Common Emitter Configuration • Voltage gain • Current Gain • Power Gain.	Textbook Journal Chart Animations Computer Projector Whiteboard Marker	Conduct an experiment on measurement of direct current in a circuit. Carry out experiment to measure the effect of resistance and observe the effect of voltage in controlling current in a circuit.	Guide students to: Conduct an experiment on measurement of direct current in a circuit. Carry out experiment to measure the effect of resistance and observe the effect of voltage in controlling current in a circuit.	Breadboard Oscilloscope Electrolytic capacitor Small voltage transformers Resistors

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	• Power Gain. 4.4 Describe Common Collector Configuration • Voltage gain • Current gain • Power gain 4.5 Describe Common Base Configuration • Voltage gain • Current gain • Power gain 4.6 Describe Field Effect. 4.7 Explain Basic FET Operation 4.8 Define Maximum Transistor Rating. 4.9 Describe Waveform Distortion	Explain Common Collector Configuration • Voltage gain • Current gain • Power gain Explain Common Base Configuration • Voltage gain • Current gain • Power gain Describe Field Effect. Explain Basic FET Operation Explain Maximum Transistor Rating. Explain Waveform Distortion Explain the importance of input Resistance at Transistor Base.		Perform an experiment to observe and measure input and output waveforms of a full – wave rectifier Carry out experiment to determine the time constant of a Capacitor Perform an experiment to show Zener diode as a Voltage regulator. Carry out experiment to show Static Characteristic of a PNP Transistor in the Common base configuration Test Bipolar Junction Transistor. Test PN Junction diode with Multimeter	Perform an experiment to observe and measure input and output waveforms of a full – wave rectifier Carry out experiment to determine the time constant of a Capacitor Perform an experiment to show Zener diode as a Voltage regulator. Carry out experiment to show Static Characteristic of a PNP Transistor in the Common base configuration Test Bipolar Junction Transistor. Test PN Junction diode with Multimeter	

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	4.10 Describe the importance of input Resistance at Transistor Base. 4.11 Describe: • Base Bias • Emitter Bias • Collector feedback bias. 4.12 Define Q – Point Stability over temperature.	Explain: • Base Bias • Emitter Bias • Collector feedback bias. Explain Q – Point Stability over temperature.				
General Objective 5.0: Understand the basic structure and application of Thyristor						
12 -15	5.1 Explain thyristor 5.2 Explain two transistor model of a thyristor 5.3 Describe Forward break over voltage and Switching Current. 5.4 Describe working principles of the thyristor	Explain thyristor Explain two transistor model of a thyristor Explain Forward break over voltage and Switching Current Explain working principles of the thyristor	Textbook Journal Chart Animations Computer Projector Whiteboard Marker	Perform experiment to determine the Characteristic of thyristors Carry out experiment to show Static Characteristic Thyristors	Guide students to: Perform experiment to determine the Characteristic of thyristors Carry out experiment to show Static Characteristic Thyristors	Thyristor IGBT SCR Solid state relay Breadboard Oscilloscope

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	5.5 Describe Holding Current and Switching Current. 5.6 Describe the Silicon Controlled Rectifier (SCR) 5.7 Describe the insulated gate bipolar transistor (IGBT) 5.8 Describe Turning ON the SCR 5.9 Describe Half-wave Controlled rectification 5.10 Describe full-wave Controlled rectification 5.11 Describe Lighting System for Power Interruption	Explain Holding Current and Switching Current. Explain the Silicon Controlled Rectifier (SCR) Explain the insulated gate bipolar transistor (IGBT) Explain Turning ON the SCR Explain Half-wave Controlled rectification Explain full-wave Controlled rectification Explain Lighting System for Power Interruption		Carry out experiment to investigate thyristor switching	Carry out experiment to investigate thyristor switching	

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	5.12 Describe an overvoltage protection circuit 5.13 Describe DIAC 5.14 Explain the switching function of DIAC 5.15 Outline the Advantages of the Thyristor.	Explain an overvoltage protection circuit Explain DIAC Explain the switching function of DIAC Explain the Advantages of the Thyristor.				
ASSESSMENT: Assessment: The practical class will be awarded 60% of the total score. The continuous assessments, tests and quizzes will be 10% the total score, while the remaining 30% will be for the end of semester examination.						

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Electrical Engineering Science II

PROGRAMME: NATIONAL DIPLOMA IN ELECTRICAL AND ELECTRONICS ENGINEERING TECHNOLOGY		
COURSE TITLE: Electrical Engineering Science II	**CODE:** EEC 124	**CONTACT HOURS:** 3
	CREDIT UNIT: 3	**THEORETICAL:** 1
YEAR: I SEMESTER: II	**PRE-REQUISITE:** EEC 114	**PRACTICAL:** 2
GOAL: This course is designed to equip students with the knowledge of fundamentals of Alternating Current (AC) theory.		
GENERAL OBJECTIVES: On completion of this course, the student should be able to:		

1.0 Understand the concepts of magnetism and magnetic circuits.
2.0 Understand the concepts of electromagnetism and electromagnetic induction.
3.0 Understand the concepts of inductance and its applications.
4.0 Understand the fundamentals of AC theory.

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PROGRAMME: NATIONAL DIPLOMA IN IN ELECTRICAL AND ELECTRONICS ENGINEERING TECHNOLOGY						
COURSE TITLE: Electrical Engineering Science II		**COURSE CODE:** EEC 124		**CONTACT HOURS:** 3		
		CREDIT UNIT: 3		**THEORETICAL:** 1		
YEAR: I **SEMESTER:** II		**PRE-REQUISITE:** EEC 114		**PRACTICAL:** 2		
COURSE SPECIFICATION: THEORETICAL AND PRACTICAL						
GOAL: This course is designed to equip students with the knowledge of fundamentals of Alternating Current (AC) theory						
General Objective 1.0: Understand the concepts of magnetism and magnetic circuits.						
THEORETICAL CONTENT				**PRACTICAL CONTENT**		
Week	**Specific Learning Outcome**	**Teachers' Activities**	**Resources**	**Specific Learning Outcome**	**Teachers' Activities**	**Resources**
1 – 3	1.1 Explain: • Magnetic flux, • magnetic flux density • Electro-motive force • Magnetomotive force • Magnetic field strength, • Reluctance, • Permeability of free space (magnetic constant) • Relative permeability. 1.2 Explain the concept of Hysteresis and B-H curve	Explain: • Magnetic flux, • magnetic flux density • Electro-motive force • Magnetomotive force • Magnetic field strength, • Reluctance, • Permeability of free space (magnetic constant) • Relative permeability. Explain the concept of Hysteresis and B-H curve	Textbooks Journals Whiteboard Marker Charts Animations Computer Projector	Determine the B-H curve for magnetic material (Hysteresis curve) Determine the magnetic energy loss in magnetic materials	Guide students to: Determine the B-H curve for magnetic material (Hysteresis curve). Determine the magnetic energy loss in a magnetic material	Magnetic materials Magnet Inductor Voltmeter Ammeter Flux meter Electronic trainer

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	1.3 Describe the symbols, units and relationships of terms in (1.1) above. 1.4 Explain the electrical equivalent of magnetic circuits with or without air-gap. 1.5 Explain the analogies between electrical and magnetic circuits. 1.6 Explain how to solve simple magnetic circuit problems. 1.7 Distinguish between soft and hard magnetic materials.	Explain the symbols, units and relationships of terms in (1.1) above. Explain the electrical equivalent of magnetic circuits with or without air-gap. Explain the analogies between electrical and magnetic circuits. Explain how to solve simple magnetic circuit problems. Distinguish between soft and hard magnetic materials				
General Objective 2.0: Understand the concepts of electromagnetism and electromagnetic induction						
4 -8	2.1 Explain heating and magnetic effects on current carrying conductor	Explain heating and magnetic effects on current carrying conductor Explain with aid of diagram the magnetic	Textbooks Journals Whiteboard Marker Charts Animations	Verify Faraday's law of electromagnetic induction	Guide student to: Verify Faraday's law of electromagnetic induction	Magnetic material(para-magnetic Diamagnetic and fero-

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	2.2 Explain with aid of diagram the magnetic fields around: • Straight conductors • Adjacent parallel Conductors • Solenoids. 2.3 Explain the force on a current carrying conductor in a magnetic field. 2.4 State the direction of the force in (2.3) above. 2.5 Derive the expression for the magnitude of the force in 2.4 above. 2.6 Explain the concept of electromagnetic induction. 2.7 State Faraday's and Lenz's Laws of electromagnetic induction.	fields around: • Straight conductors • Adjacent parallel Conductors • Solenoids. Explain the force on a current carrying conductor in a magnetic field. State the direction of the force in (2.3) above. Derive the expression for the magnitude of the force in 2.4 above. Explain the concept of electromagnetic induction. State Faraday's and Lenz's Laws of electromagnetic induction. Derive the expressions for the magnitude of Electro-motive Force (EMF)	Computer Projector .	Verify Lenz's law of electromagnetic induction. Determine the inductance of a coil. Determine energy loss in an inductor.	Verify Lenz's law of electromagnetic induction. Determine the inductance of a coil. Determine energy loss in an inductor.	magnetic) Magnet, Inductor Voltmeter Ammeter Flux meter Electronic trainers

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	2.10 Derive the expressions for the magnitude of Electro-motive Force (EMF) induced in a conductor or a coil. **2.11** Explain how to solve problems involving electromagnetic induction and the magnitude of induced EMF. 2.10 State the applications of electromagnetic induction.	induced in a conductor or a coil. Explain how to solve problems involving electromagnetic induction and the magnitude of induced EMF. Explain the applications of electromagnetic induction.				
General Objective: 3.0 Understand the concepts of inductance and its applications						
9-11	3.1 Define self and mutual inductance and their symbols. 3.2 Explain the expression for the equivalent inductance of inductances connected in series and parallel.	Define self and mutual inductance and their symbols. Explain the expression for the equivalent inductance of inductances connected in series and parallel.	Textbooks Journals Whiteboard Marker Charts Animations Computer Projector	Determine the energy loss in an inductor. Determine the equivalent inductance of serial and parallel inductive circuits.	Guide students to: Determine the energy loss in an inductor. Determine the equivalent inductance of serial and parallel	Magnetic material (para-magnetic Diamagnetic and fero-magnetic) Magnet

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	3.3 Explain the expression for the induced voltage across an inductor. 3.4 Explain the expression for mutual inductance in coupled coils connected in series aiding or opposing. 3.5 Explain how to calculate the stored energy in an inductor. 3.6 Explain how to solve problem involving series, parallel inductive circuits. 3.7 Explain using diagram the operation of the induction coiled in a car ignition system.	Explain the expression for the induced voltage across an inductor. Explain the expression for mutual inductance in coupled coils connected in series aiding or opposing. Explain how to calculate the stored energy in an inductor. Explain how to solve problem involving series, parallel inductive circuits. Explain using diagram the operation of the induction coiled in a car ignition system		Determine the magnetic coupling in a transformer	inductive circuits. Determine the magnetic coupling in a transformer	(neodymium) Inductor Voltmeter Ammeter Flux meter Transformer Coil Electronic trainers
General Objective 4.0: Understand the fundamentals of Alternating Current (AC) Theory						
12- 15	4.1 Describe the production of an alternating EMF by a rotating coil in a	Describe the production of an alternating EMF by a rotating coil in a magnetic	Textbooks Journals Whiteboard,	Determine the frequency, period and amplitude of a	Guide student to: Determine the frequency, period	Magnetic material (para-magnetic

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	magnetic field. 4.2 Explain AC waveforms both to scale and not to scale. 4.3 Define: • Root Mean Square (RMS) • Instantaneous, • Average value • Peak value • Period • Frequency of an AC waveform. 4.4 State the relationships between instantaneous and peak values of a sinusoidal wave signals. 4.5 Explain how to solve problems involving (4.2 - 4.4) above. 4.6 Explain how to solve problems graphically on AC circuits with	field. Explain AC waveforms both to scale and not to scale. Define: • Root Mean Square (RMS) • Instantaneous, • Average value • Peak value • Period • Frequency of an AC waveform. State the relationships between instantaneous and peak values of a sinusoidal wave signals. Explain how to solve problems involving (4.2 - 4.4) above. Explain how to solve	Marker Charts Animations Computer Projector	sinusoidal signal. Determine the series and parallel resonance of an AC circuit. Determine the Quality-factor (Q-factor) of series and parallel RLC circuits.	and amplitude of a sinusoidal signal. Determine the series and parallel resonance of an AC circuit. Determine the Quality-factor (Q-factor) of series and parallel RLC circuits	Diamagnetic and fero-magnetic) Oscilloscope Signal generator Voltmeter Ammeter Resistor Inductor Capacitors Connecting cable Electronic trainer.

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	different combinations of resistance, inductance and capacitance i.e. RLC circuits. 4.6 Differentiate between series and parallel resonances. 4.7 Explain phase lag or phase lead as applied to AC circuits. 4.8 Explain the difference between single and 3-phase supply 4.10 State the advantages and disadvantages of 3-phase supply and single phase supply.	problems graphically on AC circuits with different combinations of resistance, inductance and capacitance i.e. RLC circuits. Differentiate between series and parallel resonances. Explain phase lag or phase lead as applied to AC circuits. Explain the difference between single and 3-phase supply. Explain the advantages and disadvantages of 3-phase supply and single phase supply.				
ASSESSMENT: The practical class will be awarded 60% of the total score. The continuous assessments, test and quizzes will take 10% of the total score, while the remaining 30% will be for the end of semester examination score.						

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Electrical and Electronics measurement and Instrumentation

PROGRAMME: NATIONAL DIPLOMA IN ELECTRICAL AND ELECTRONICS ENGINEERING TECHNOLOGY		
COURSE TITLE: Electrical and Electronics **measurement and** Instrumentation	**CODE:** EEC 125	**CONTACT HOURS:** 4
	CREDIT UNIT: 2	**THEORETICAL:** 1
YEAR: I **SEMESTER:** II	**PRE-REQUISITE:**	**PRACTICAL:** **3**
GOAL: This course is designed to acquaint the students with the knowledge and skills of application of electrical/electronic instruments for laboratory and industrial measurements		
GENERAL OBJECTIVES: At the end of the course the student should be able to: 1.0 Know electrical and electronic instruments. 2.0 Understand error in measurement. 3.0 Understand measurement instruments in electrical and electronics systems. 4.0 Understand the working principles and constructions of measuring instruments		

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PROGRAMME: NATIONAL DIPLOMA IN ELECTRICAL AND ELECTRONICS ENGINEERING					
COURSE TITLE: Electrical and Electronics **measurement and** Instrumentation		**COURSE CODE:** EEC 125		**CONTACT HOURS:** 4	
		CREDIT UNIT: 2		**THEORETICAL:** 1	
YEAR: I **SEMESTER:** II		**PRE-REQUISITE:**		**PRACTICAL:** 3	
GOAL: This course is designed to acquaint the students with the knowledge and skills of application of electrical/electronic instruments for laboratory and industrial measurements					
General Objective: 1.0: Know electrical and electronic instruments.					
THEORETICAL CONTENT				**PRACTICAL CONTENT**	
Week	**Specific Learning Outcome**	**Teachers' Activities**	**Resources**	**Specific Learning Outcome**	**Teachers' Activities**	**Resources**
1-2	1.1 Explain commonly used Electrical and Electronic Measurement Instruments: • Digital multimeter • Analogue multimeter • Voltage tester	Explain commonly used Electrical and Electronic Measurement Instruments: • Digital multimeter • Analogue multimeter	Textbooks Journals Whiteboard Marker Charts Animations Computer Projector	Identify the instruments listed below: • Digital multimeter • Analogue multimeter • Voltage	Guide the Students to: Identify the instruments listed below: • Digital multimeter • Analogue multimeter	Digital Oscilloscope Signal generator d.c/a.c Power

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	• Clamp meter • Oscilloscope • Insulation resistance tester (Megger) • Tachometer • Wattmeter • Thermometer • Frequency Counters • Battery tester 1.2 Explain the applications of the instruments listed in 1.1 above. 1.3 State the range of each type of electrical and electronics instruments.	• Voltage tester • Clamp meter • Oscilloscope • Insulation resistance tester (Megger) • Tachometer • Wattmeter • Thermometer • Frequency Counters • Battery tester Explain the applications of the instruments listed in 1.1 above Explain the range of each type of electrical and electronics instruments		tester • Clamp meter • Oscilloscope • Insulation resistance tester (Megger) • Tachometer • Wattmeter • Thermometer • Frequency Counters • Battery tester Demonstrate ohm's law using variable resistance and variable E.M.F	• Voltage tester • Clamp meter • Oscilloscope • Insulation resistance tester (Megger) • Tachometer • Wattmeter • Thermometer • Frequency Counters • Battery tester Demonstrate ohm's law using variable resistance and variable E.M.F	supplies Probe Voltage testers Clamp meters Frequency counter Resistors Cables Insulation continuity tester Voltage sources.
General Objective: 2.0 Understand error in measurement						

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3-5	2.1 Define error in measurement 2.2 Explain types of errors in measurement. 2.3 Explain the differences between Random and Static error in electrical measurement. 2.3 Define Resistance. 2.4 State Kirchhoff's current and voltage law. 2.5 State Superposition theorem.	Explain error in measurement Explain types of errors in measurement. Explain the differences between Random and Static error in electrical measurement. Explain Resistance. Explain Kirchhoff's current and voltage law. Explain Superposition theorem.	Textbooks Journals Whiteboard Marker Charts Animations Computer Projector	Demonstrate practical examples of error Determine the resistivity of materials Verify Kirchhoff's current and voltage law Demonstrate superposition Theorem	Guide students to: Demonstrate practical examples of error Determine the resistivity of materials Verify Kirchhoff's current and voltage law Demonstrate superposition Theorem	Capacitors Inductor e.m.f sources Voltmeter and ammeter
General Objective 3.0: Understand measurement instruments in electrical and electronics systems.						
6-8	3.1 Explain the following: • Digital multimeter • Analogue multimeter • Voltage tester • Clamp meter	Explain the following: • Digital multimeter • Analogue multimeter	Textbooks Journals Whiteboard Marker Charts Animations	Demonstrate the use of the following using different circuits: • Digital multimeter	Guide students to: Demonstrate the use of the following using different circuits: • Digital	Digital multimeter Analogue multimeter

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	• Oscilloscope 3.2 Explain the operating principles measuring instruments 3.3 Explain the different selector ranges on a digital multimeter to be used as: • Ammeter (AC/DC) • Voltmeter. (AC/DC) 3.4 Explain how a multiplier and Shunt can be used to increase the range of Voltmeter and ammeter respectively. 3.5 Explain how to calculate the Values of the multiplier and shunt.	• Voltage tester • Clamp meter • Oscilloscope Explain the operating principles of measuring instruments Explain the different selector ranges on a digital multimeter to be used as • Ammeter (AC/DC) • Voltmeter. (AC/DC) Explain how a multiplier and Shunt can be used to increase the range of Voltmeter and ammeter respectively. Explain how to calculate the Values of the multiplier and	Computer Projector	• Analogue multimeter • Voltage tester • Clamp meter • Oscilloscope Measure voltage and current by connecting Multiplier and Shunt respectively. Charge and discharge a capacitor, inductor Calibrate and measure with multimeter. Measure direct current (d.c) voltage in experiments using multimeter Measure alternating current	multimeter • Analogue multimeter • Voltage tester • Clamp meter • Oscilloscope Measure voltage and current by connecting Multiplier and Shunt respectively. Charge and discharge a capacitor, inductor Calibrate and measure with multimeter Measure direct current (d.c) voltage in experiments using	Voltage tester Clamp meter Oscilloscope

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		shunt.		(a.c) voltage in experiments using digital multimeter Calculate the Values of the multiplier and shunt. Calibrate a moving coil instrument	multimeter Measure alternating current (a.c) voltage in experiments using digital multimeter Calculate the Values of the multiplier and shunt. Calibrate a moving coil instrument	
General Objective 4.0: Understand the working principles and constructions of meters and merger						
9-11	4.1 Explain the following meters: • Digital Voltmeter • Frequency Counter • Ohmmeter • Ammeter • Merger • LCR meter 4.2 Explain earth point	Explain the following meters: • Digital Voltmeter • Frequency Counter • Ohmmeter • Ammeter • Merger • LCR meter Explain earth point	Textbooks Journals Whiteboard Marker Charts Animations Computer Projector	Use meters to measure • Voltage • Current • Variable frequencies • Earth resistance • Insulation resistance • Current	Guide students to: Use meters to measure • Voltage • Current • Variable frequencies • Earth resistance • Insulation resistance • Current (Clamp meter)	Capacitors Inductor e.m.f sources Resistors Voltmeter and ammeter Insulation resistance

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	4.3 Explain the working principles of the instruments in 4.1 above. 4.4 Explain features of the instruments in 4.1 above. 4.5 Explain functions and constructions of the instruments in 4.1 above.	Explain the working principles of the instruments in 4.1 above. Explain features of the instruments in 4.1 above. Explain functions and constructions of the instruments in 4.1 above.		(Clamp meter) Sketch a diagram of the following meters: • Digital Voltmeter • Frequency Counter • Ohmmeter • Ammeter • Merger • LCR meter Identify earth point	Sketch a diagram of the following meters: • Digital Voltmeter • Frequency Counter • Ohmmeter • Ammeter • Merger • LCR meter Identify earth point	tester LCR meter.
ASSESSMENT: The practical class will be awarded 60% of the total score. The continuous assessments, test and quizzes will cover 10% of the total score, while the remaining 30% will be for the end of the semester examination.						

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Telecommunication I

PROGRAMME: NATIONAL DIPLOMA IN ELECTRICAL AND ELECTRONICS ENGINEERING TECHNOLOGY		
COURSE TITLE: Telecommunication I	**COURSE CODE:** EEC 126	**CONTACT HOURS:** 3
	CREDIT UNIT: 2	**THEORETICAL:** 1
YEAR: I **SEMESTER:** II	**PRE-REQUISITE:**	**PRACTICAL:** 2
GOAL: This course is designed to equip the students with the knowledge and skills of the principles of telecommunication techniques.		
GENERAL OBJECTIVES: On completion of this course, students should be able to: 1.0 Understand the basic principles of telecommunication system 2.0 Understand the principles of operation and application of various transducers. 3.0 Understand the basic principles of modulation and demodulation of signals. 4.0 Understand the principles of receivers.		

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PROGRAMME: NATIONAL DIPLOMA IN IN ELECTRICAL AND ELECTRONICS ENGINEERING TECHNOLOGY						
COURSE TITLE: Telecommunication I		**COURSE CODE:** EEC 126		**CONTACT HOURS:** 3		
		CREDIT UNIT: 2		**THEORETICAL:** 1		
YEAR: I **SEMESTER:** II		**PRE-REQUISITE:**		**PRACTICAL:** 2		
GOAL: This course is designed to equip the students with the knowledge and skills of the principles of telecommunication techniques.						
General Objective 1.0: Understand the basic principles of telecommunication system						
THEORETICAL CONTENT				**PRACTICAL CONTENT**		
Week	**Specific Learning Outcomes**	**Teachers' Activities**	**Resources**	**Specific Learning Outcome**	**Teachers' Activities**	**Resources**
1 – 2	1.1 Define telecommunication 1.2 Explain the block diagram of a simple communication system. 1.3 Explain transducer 1.4 Explain the types of transducers 1.5 Explain the functions of each of the segments in the block diagram in (1.2) above.	Explain telecommunication Explain the block diagram of a simple communication system Explain transducer Explain the types of transducers Explain the functions of each of the segments in the block diagram in (1.2) above.	Textbooks Journals Whiteboard Marker Charts Animations Computer Projector.	Visit a communication service provider company Identify the basic segments in the block diagram of the communication system.	Guide students to: Visit a communication service provider company Identify the basic segments in the block diagram of the communication system.	Sample block diagram of a communication system Videoclips Communication trainer
General Objective 2.0: Understand the principles of operation and application of various transducers.						
3 – 5	2.1 Describe sound	Explain sound	Textbooks			

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	transducers: • Microphones • Speakers 2.2 Explain with the aid of diagrams the principles of operation of sound transducers 2.3 Explain the applications of sound transducers.	transducers: • Microphones • Speakers Explain with the aid of diagrams the principles of operation of sound transducers Explain the applications of sound transducers.	Journals Whiteboard Marker Charts Animations Computer Projector.			
General Objective 3.0: Understand the basic principles of modulation and demodulation of signals.						
6 – 8	3.1 Define modulation and demodulation 3.2 Explain the applications of modulation and demodulation in communication systems. 3.3 Explain the modulation techniques. 3.4 Explain the working principles of amplitude	Explain modulation and demodulation Explain the applications of modulation and demodulation in communication systems. Explain the modulation techniques. Explain the working	Textbooks Journals Whiteboard Marker Charts Animations Computer Projector.	Visit AM and FM radio stations Demonstrate modulation and demodulation in AM and FM Modes	Organize Visit to AM and FM radio stations Guide students to Demonstrate modulation and demodulation in AM and FM Modes	Communication trainer, AM transmitter and receiver trainer, FM transmitter and receiver trainer, Oscilloscope, Oscillator,

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	demodulators. 3.4 Explain the following terms regarding amplitude modulation (AM): • Carrier frequency • Audio frequency • Side frequencies • Side band • Modulation index • Modulation envelope • Bandwidth 3.5 Explain the working principles of frequency demodulators. 3.6 Explain the following terms regarding Frequency Modulation (FM): • Modulation index • Deviation ratio • Frequency deviation	principles of amplitude demodulators Explain the following terms regarding amplitude modulation (AM): • Carrier frequency • Audio frequency • Side frequencies • Side band • Modulation index • Modulation envelope • Bandwidth Explain the working principles of frequency demodulators. Explain the following terms regarding Frequency Modulation (FM): • Modulation index				

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	• System deviation • Frequency swing 3.7 Explain why FM has a wider bandwidth than AM. 3.8 Explain the differences between the parameters of FM with AM. 3.9 Explain how to solve problems involving (3.4) and (3.6) above.	• Deviation ratio • Frequency deviation • System deviation • Frequency swing Explain why FM has a wider bandwidth than AM. Explain differences between the parameters of FM with AM. Explain how to solve problems involving (3.4) and (3.5) above.				
General Objective 4.0: Understand the principles of operation of receivers.						
12-15	4.1 Define a receiver 4.2 Explain the types of receivers 4.3 Explain by using diagram the function of receivers.	Explain receiver Explain the types of receivers Explain by using diagram the function of receivers.	Textbooks Journals Whiteboard Marker Charts Animations Computer Projector.	Visit AM and FM Radio stations Demonstrate the operation of receivers using receiver trainer	Guide students to: Visit AM and FM Radio stations Demonstrate the operation of receivers using receiver trainer	Communication trainer AM transmitter and receiver trainer FM transmitter and receiver

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	4.4 Explain the choice of intermediate frequency in receivers. 4.5 Explain adjacent channel and image interferences in receivers. 4.6 Explain the use of receiver to suppress image and adjacent channel interferences. 4.7 Explain the function of Automatic Gain Control (AGC). 4.8 Explain with the aid of a block diagram, the working principles of an FM radio receiver.	Explain the choice of intermediate frequency in receivers. Explain adjacent channel and image interferences in receivers. Explain the use of receiver to suppress image and adjacent channel interferences. Explain the function of the automatic gain control (AGC). Explain with the aid of a block diagram, the working principles of an FM radio receiver.				trainer Oscilloscope Oscillator
ASSESSMENT: The practical class will be awarded 60% of the total score. The continuous assessments, tests and quizzes will be 10% the total score, while the remaining 30% will be for the end of Semester examination.						

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Electrical Installation of Buildings

PROGRAMME: NATIONAL DIPLOMA IN ELECTRICAL AND ELECTRONICS ENGINEERING TECHNOLOGY		
COURSE TITLE: Electrical Installation of Buildings	**COURSE CODE:** EEC 127	**CONTACT HOURS:** 3
	CREDIT UNIT: 2	**THEORETICAL:** 1
YEAR: I **SEMESTER:** II	**PRE-REQUISITE:**	**PRACTICAL:** 2
GOAL. This course is designed to equip the students with knowledge and skills to implement electrical installations of buildings.		
GENERAL OBJECTIVES: On completion of this course, the students should be able to:		

1.0 Understand electrical/electronic standard symbols.
2.0 Understand schematic, wiring diagrams and earthing system.
3.0 Interpret building drawings and symbols.
4.0 Understand cables and IEE wiring Regulations.
5.0 Understand the bill of quantities of materials for the electrical installation of building.
6.0 Understand Solar power installation, home automation and smart metering.

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PROGRAMME: NATIONAL DIPLOMA IN ELECTRICAL AND ELECTRONICS ENGINEERING TECHNOLOGY			
COURSE TITLE: Electrical Installation of Buildings		**COURSE CODE:** EEC 127	**CONTACT HOURS:** 3
		CREDIT UNIT: 2	**THEORETICAL:** 1
YEAR: I **SEMESTER:** II		**PRE-REQUISITE:**	**PRACTICAL:** 2
COURSE SPECIFICATION: THEORETICAL AND PRACTICAL			
GOAL: This course is designed to equip the students with knowledge and skills to implement electrical installations of buildings.			
General Objective 1.0: Understand electrical/electronic standard symbols.			

THEORETICAL CONTENT				**PRACTICAL CONTENT**		
Week	**Specific Learning Outcome**	**Teachers' Activities**	**Resources**	**Specific Learning Outcome**	**Teachers' Activities**	**Resources**
1-2	1.1 Define standard symbol. 1.2 Explain electrical drafting. 1.3 Explain electrical standard symbols of the following: • Resistor. • Capacitor • Inductor • Diodes • Thyristor • Diac • Triac • Operational • Amplifier • Oscillator	Explain standard symbol. Explain electrical drafting. Explain electrical standard symbols of the following: • Resistor. • Capacitor • Inductor • Diodes • Thyristor • Diac • Triac • Operational • Amplifier • Oscillator	Textbook Journals Whiteboard Marker Charts Animation Computer Projector.	Identify the standard symbols Sketch the standard symbols	Guide students to : Identify the standard symbols Sketch the standard symbols	Sample symbols Charts Video clips Electrical training modules Safety charts/posters Fire extinguisher

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	• Logic gates • Linear • IC • PV panel • Charge Controller • Battery • Inverter • Surmisable water • Pump • Power Switches • Sockets • Isolator Switch • Circuit Breakers • Electrical Motors • Electrical Generators • AC/Fans • ELCB. • Distribution Board • Junction box • Lamp holder • Camera • TV • Audio cable • Single and Multi-core Power cables.	• Logic gates • Linear • IC • PV panel • Charge Controller • Battery • Inverter • Surmisable water • Pump • Power Switches • Sockets • Isolator Switch • Circuit Breakers • Electrical Motors • Electrical Generators • AC/Fans • ELCB. • Distribution Board • Junction box • Lamp holder • Camera • TV • Audio cable • Single and Multi-core Power cables.				Sand bucket First aid box

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General Objective 2.0: Understand schematic, wiring diagrams and earthing system.						
3-4	2.1 Explain schematic and Wiring Diagrams 2.2 State the merits and demerits of schematic Diagrams 2.3 State the merits and demerits of wiring diagrams 2.4 Explain the earth continuity conductor, earth electrode, and consumer's earth terminal. 2.5 Explain the earthling systems (TT,TN and IT) and their relevance to electrical installations. 2.6 Explain different protection devices of an installation such as fuses and circuit breakers.	Explain schematic and Wiring Diagrams State the merits and demerits of schematic Diagrams State the merits and demerits of wiring diagrams Explain the earth continuity conductor, earth electrode, and consumer's earth terminal. Explain the earthling systems (TT,TN and IT) and their relevance to electrical installations. Explain different protection devices of an installation such as fuses and circuit breakers.	Textbook Journals Whiteboard Marker Charts Animation Computer Projector	Interpret a schematic diagram Interpret a wiring diagram Conduct earth resistance test to ascertain the earth resistance value	Guide students to: Interpret a schematic diagram Interpret a wiring diagram Conduct earth resistance test to ascertain the earth resistance value	Sample schematic diagrams Sample wiring diagrams Earth resistance tester Power source Chart of electrical graphic symbols.

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	2.7 Explain the difference between solid earthling practice and earth leakage circuit breaker (ELCB) protection. 2.8 Explain the problems associated with earth leakage circuit breaker. 2.9 Explain how the human body can become part of an electric circuit. 2.10 Explain how to prevent electric shock. 2.11 Explain the methods of treating electric shock. 2.12 Enumerate the current and voltage threshold for human body	Explain the difference between solid earthling practice and earth leakage circuit breaker (ELCB) protection. Explain the problems associated with earth leakage circuit breaker. Explain how the human body can become part of an electric circuit. Explain how to prevent electric shock. Explain the methods of treating electric shock. Explain the current and voltage threshold for human body				

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General Objective 3.0: Interpret Building drawings and symbols.						
4-5	3.1 Explain electrical symbols. 3.2 Explain building drawings 3.3 Explain the role of electrical engineers in building drawings 3.4 Explain how to interpret building drawings	Explain electrical symbols. Explain building drawings Explain the role of electrical engineer in building drawings Explain how to interpret building drawings	Textbook Journals Whiteboard Marker Charts Animation Computer Projector	Identify electrical symbols Insert electrical symbols for the installation layout in building drawings Produce a single line diagram based on the layout Interpret building drawings.	Guide the students to: Identify electrical symbols Insert electrical symbols for the installation layout in building drawings Produce a single line diagram based on the layout Interpret building drawings.	Sample building plan Sample single line diagram Electrical graphic symbols Drawing instruments Sample wiring diagrams Computers with installed drawing software
GENERAL OBJECTIVE 4.0: Understand cables and IEE wiring Regulations.						
6-8	4.1Define a cable 4.2 Explain types of cables 4.3 Explain the differences	Explain a cable Explain types of cables Explain the differences	Textbook Journals Whiteboard Marker Charts	Identify cables and their sizes Select	Guide students to: Identify cables and their sizes	Cables Trunk Electrical

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	between cable and a conductor 4.4 Explain cable sizes 4.5 Explain Service main and consumer terminal 4.6 Explain Circuit and Sub-circuit. 4.7 Explain electrical power diversity factor, ambient temperature, classes of excess current protection, and disposition of cable 4.8 Explain the IEE tables for selecting cables. 4.9 Explain the thermal durability of cables in case of short-circuit 4.10 Explain how to calculate the total load current for a final Sub-circuit in the	between cable and a conductor Explain cable sizes Explain Service main and consumer terminal Explain Circuit and Sub-circuit. Explain electrical power diversity factor, ambient temperature, classes of excess current protection, and disposition of cable Explain the IEE tables for selecting cables. Explain the thermal durability of cables in case of short-circuit Explain how to calculate the total load current for a final Sub-circuit in the building	Animation Computer Projector	appropriate cables for different uses Draft electrical services for a residential building e.g. 3-bedroom flat Demonstrate installation of various types of joints using PVC flexible cables. Design an electrical service for a 3- bedroom flat. Identify cable colour coding commonly used in Nigeria.	Select appropriate cables for different uses Draft electrical services for a residential building e.g. 3-bedroom flat Demonstrate installation of various types of joints using PVC flexible cables. Design an electrical service for a 3- bedroom flat. Identify cable colour coding commonly used in Nigeria.	graphic symbols Drawing instruments Sample wiring diagrams Cable color code Computers with installed drawing software

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	building 4.11 List the main types of insulation and conducting materials used in cables. 4.12 Distinguish between conductors and insulators. 4.13 Describe with the aid of sketches, the construction of different types of cables. 4.14 State the advantages and disadvantages of the following: • PVE – Insulated PVC - sheathed cable. • Mineral - Insulated metal - sheathed cable • Armoured PVC – insulated PVC - sheathed cable • Flexible cable and cord	 List the main types of insulation and conducting materials used in cables. Distinguish between conductors and insulators. Describe with the aid of sketches, the construction of different types of cables. Explain the advantages and disadvantages of the following: • PVE – Insulated PVC - sheathed cable. • Mineral - Insulated metal - sheathed cable • Armoured PVC – insulated PVC - sheathed cable • Flexible cable and cord		Carryout laying of cables using different trunking methods. Apply I.E.E. wiring Regulations related to cables and their uses. Identify types of joints	Carryout laying of cables using different trunking methods. Apply I.E.E. wiring Regulations related to cables and their uses. Identify types of joints	

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	• Steel and PVC Conduits • Steel and PVC trunking. • XLPE insulator cable 4.15 Explain trunking and ducting 4.16 Explain cable piping and laying 4.17 Explain the I.E.E. wiring Regulations related to cables and their uses. 4.18 Explain the cable colour coding, commonly used in Nigeria. 4.19 State various types of joints	• Steel and PVC Conduits • Steel and PVC trunking. • XLPE insulator cable Explain trunking and ducting Explain cable piping laying Explain the I.E.E. wiring Regulations related to cables and their uses. Explain the cable colour coding, commonly used in Nigeria. Explain various types of joints				
General Objective 5.0: Understand bill of quantities of materials for the electrical installation of building						
9-11	5.1 Explain bill of quantity 5.2 Explain items in bill of quantities.	Explain bill of quantity Explain items in bill of quantities.	Textbook Journals Whiteboard Marker Charts	Extract items for bill of quantities from drawings.	Guide students to: Extract items for bill of quantities from	Sample bill of quantity Sample market survey report

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	5.3 Explain how to extract items for bill of quantities from drawings. 5.4 Explain the importance of market survey in creating a bill of quantity 5.5 Explain the importance of bill of quantities for the electrical installation of building 5.6 Explain how to assess the cost of materials. 5.7 Explain how to prepare typical bills of engineering measurements and materials for an electrical installation.	Explain how to extract items for bill of quantities from drawings. Explain the importance of market survey in creating a bill of quantity Explain the importance of bill of quantities for the electrical installation of building Explain how to assess the cost of materials. Explain how to prepare typical bills of engineering measurements and materials for an electrical installation	Animation Computer Projector	Conduct market survey (hypothetical) Assess the cost of materials. Prepare typical bill of quantity	drawings. Conduct market survey (hypothetical) Assess the cost of materials. Prepare typical bill of quantity	
General Objective 6.0: Understand Solar power installation, home automation and smart metering						
12-15	6.1 Explain the concept of Solar power system. 6.2 List the components of Solar power system	Explain the concept of Solar power system. List the components of Solar power system	Textbook Journals Whiteboard Marker Charts Animation	Identify the components of Solar power system.	Guide students to: Identify the components of Solar power system.	PV panels Charge Controllers

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	6.3 Explain the functions of each component in 6.2 above 6.4 Explain TV cabling and installation 6.5 Explain Closed-Circuit Television (CCTV). 6.6 List the components of Closed-Circuit Television (CCTV). 6.7 Explain the layout of a Closed-Circuit Television (CCTV). 6.8 Explain the diagram of electrical service mains of residential and commercial/industrial premises 6.9 Explain prepaid energy meters in domestic and commercial/industrial premises.	Explain the functions of each component in 6.2 above Explain TV cabling and installation Explain Closed-Circuit Television (CCTV). List the components of Closed-Circuit Television (CCTV). Explain the layout of a Closed-Circuit Television (CCTV). Explain the diagram of electrical service mains of residential and commercial/industrial premises Explain prepaid energy meters in domestic and commercial/industrial premises.	Computer Projector	Install Closed-Circuit Television (CCTV). Install a satellite Television with its accessories. Install Electrical service mains for a premises Install a prepaid meter in a premises	Install Closed-Circuit Television (CCTV). Install a satellite Television with its accessories. Install Electrical service mains for a premises Install a prepaid meter in a premises	Battery storage Inverter Fuses Cables Circuit breaker. For CCTV: Cameras. Lenses Mountings and covers Communication media such as cables. Main supply, Video cables, Switch and synchronizers, TV monitors, Decoder, satellite Television.

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						For Prepaid meter: Energy meter Optocoupler Relay Load Driver LED EEPROM Microcontroller Display.
ASSESSMENT: The Practical class will be awarded 60% of the total score. The continuous assessments, tests and quizzes will take 10% of the total score while the remaining 30 % will be for the end-of-the-semester examination score.						

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YEAR TWO, SEMESTER ONE

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Logic and Linear Algebra

PROGRAMME: NATIONAL DIPLOMA IN ELECTRICAL AND ELECTRONICS ENGINEERING TECHNOLOGY		
COURSE: Logic and Linear Algebra	**COURSE CODE:** MTH 202	**CONTACT HOURS:** 2
	CREDIT UNIT: 2	**THEORETICAL:** 2
YEAR: II **SEMESTER:** I	**PRE-REQUISITE:**	**PRACTICAL:** 0
GOAL: This course is designed to equip students with knowledge and skills to apply logical reasoning in engineering		
GENERAL OBJECTIVES: On completion of this course, the student should be able to: 1.0 Understand the concept of logic and abstract thinking 2.0 Understand the concept of permutations and combinations 3.0 Undertake the binomial expansion of algebraic expressions. 4.0 Understand the algebraic operations of matrixes and determinants		

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PROGRAMME: NATIONAL DIPLOMA IN ELECTRICAL AND ELECTRONICS ENGINEERING TECHNOLOGY					
COURSE: Logic and Linear Algebra		**COURSE CODE:** MTH 202		**CONTACT HOURS:** 2	
		CREDIT UNIT: 2		**THEORETICAL:** 2	
YEAR: II **SEMESTER:** I		**PRE-REQUISITE:**		**PRACTICAL:** 0	
COURSE SPECIFICATION: THEORETICAL AND PRACTICAL					
GOAL: This course is designed to equip students with knowledge and skills to apply logical reasoning in engineering					
General Objective 1.0: Understand the Concept of Logic and Abstract Thinking					
THEORETICAL CONTENT				**PRACTICAL CONTENT**	
Week	**Specific Learning Outcomes**	**Teacher's activities**	**Learning Resources**	**Specific Learning Outcomes**	**Teacher's activities**	**Evaluation**
1-4	1.1 Define: • Essential connectives • Negation • Conjunction • Disjunction • Implication • Bi-implication. 1.2 Illustrate the essential connectives define in 1.1 above	Explain: • Essential connectives • Negation • Conjunction • Disjunction • Implication • Bi-implication. Explain the essential connectives define in 1.1 above	Whiteboard Marker Projection Computer Internet Textbooks Lecture Notes	Translate sentences into symbolic form using quantifiers. e.g.: "some freshmen are intelligent can be stated as "for some x,x is a freshman and x is intelligent" can be translated in symbols as (ix) (f x & ix)	Guide students to: Translate sentences into symbolic form using quantifiers. e.g.: "some freshmen are intelligent can be stated as "for some x,x is a freshman and x is intelligent" can be translated in symbols as (ix) (f x & ix)	

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	1.3 Describe grouping and parenthesis in logic	Explain grouping and parenthesis in logic				
	1.4 Explain Truth tables. 1.5 Define tautology.	Explain Truth tables. Explain tautology				
	1.6 Illustrate types of tautology.	Explain types of tautology.				
	1.7 Define universal quantifier and existential quantifier	Explain universal quantifier and existential quantifier				
	1.8 Explain how to translate sentences into symbolic form using quantifiers. e.g.: "some freshmen are intelligent can be stated as "for some x,x is a freshman and x is intelligent" can be translated in symbols as (ix) (f x & ix)	Explain how to translate sentences into symbolic form using quantifiers. E.g. "some freshmen are intelligent can be stated as "for some x,x is a freshman and x is intelligent" can be translated in symbols as (ix) (f x & ix)				
	1.9 Define the scope of a quantifier. e.g.:	Explain the scope of a quantifier. e.g.:				

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	R=Gauss was a contemporary of Napoleon S=Napoleon was a contemporary of Julius Caesar (Thus P, Q and R are true, and S is false Then find the truth value of sentences: (a) (P and Q) = R (b) (P – Q) (c) PAND Q = R – S 1.10 Define bond and "free" variables. 1.11 Define term and formula. 1.12 Explain the validity of formulae	R=Gauss was a contemporary of Napoleon S=Napoleon was a contemporary of Julius Caesar (Thus P, Q and R are true, and S is false Then find the truth value of sentences: (a) (P and Q) = R (b) (P – Q) (c) PAND Q = R – S Explain bond and "free" variables. Explain term and formula. Explain the validity of formulae				
General Objective 2 : Understand the Concept of Permutations and Combinations						
5-7	2.1 Define permutation's and Combination 2.2 Explain with illustrative examples of each of 2.1 above.	Explain permutation's and Combination Explain with illustrative examples of each of 2.1 above.	Whiteboard Marker Projection Computer Internet Textbooks	Give illustrative examples of the fundamental principles of permutations.	Guide students to: Give illustrative examples of the fundamental principles of permutations.	

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	2.3 State the fundamental principle of permutations. 2.4 Explain with illustrative examples of the fundamental principles of permutations. 2.5 Explain how to establish the formula nPr = n !(n-r)! 2.6 Prove that nPr= (n-r+1) *nP_{r-1} 2.7 Explain how to solve problems of permutations with restrictions on some of. the objects 2.8 Explain how to solve problems of permutations in which the objects may be repeated.	Explain the fundamental principle of permutations. Explain with illustrative examples of the fundamental principles of permutations. Explain how to establish the formula nPr = n ! (n-r)!	Lecture Notes	Establish the formula nPr = n ! (n-r)! Solve problems of permutations with restrictions on some of. the objects Solve problems of permutations in which the objects may be repeated. Solve problems of permutations of N identical objects. State and prove the theorem nCr-1+ ^{n}Cr = ^{n+1}Cr	Establish the formula nPr = n ! (n-r)! Solve problems of permutations with restrictions on some of. the objects Solve problems of permutations in which the objects may be repeated. Solve problems of permutations of N identical objects. State and prove the theorem nCr-1+ ^{n}Cr = ^{n+1}Cr	

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	2.9 Describe circular permutations. 2.10 Explain how to solve problems of permutations of N identical objects. 2.11 Establish the formula: nCr = n! r!(n-r)! 2.12 State and prove the theorem nCr-1+ ^{n}Cr = $^{n+1}$Cr 2.13 Explain problems of combinations with restrictions on some of 2.14 Explain how to solve problems of combination of "n" different objects taken any number of it at a time.					
General Objective 3: Undertake the binomial expansion of algebraic expressions.						
8-11	3.1 Explain with illustrative examples the method of	Explain with illustrative examples	Whiteboard Marker	Illustrative with	Guide students to: Illustrative with	

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	mathematical induction. 3.2 State and prove binomial theorem for positive integral index. 3.3 Describe the properties of binomial expansion. 3.4 State the binomial theorem for a rational number. 3.5 State the properties of binomial coefficients 3.6 Explain how to apply binomial expansion in approximations (simple examples only).	the method of mathematical induction. Explain and prove binomial theorem for positive integral index. Explain the properties of binomial expansion. Explain the binomial theorem for a rational number. Explain the properties of binomial coefficients Explain how to apply binomial expansion in approximations (simple examples only).	Projection Computer Internet Textbooks Lecture Notes	examples the method of mathematical induction. Identify the binomial theorem for a rational number. Identify the properties of binomial coefficients Apply binomial expansion in approximations (simple examples only).	examples the method of mathematical induction. Identify the binomial theorem for a rational number. Identify the properties of binomial coefficients Apply binomial expansion in approximations (simple examples only).	
General Objective 4: Understand the algebraic operations of matrixes and determinants						
12-15	4.1 Define Matrix 4.2 Define the special matrixes of zero	Explain Matrix Explain the special matrixes of zero	Whiteboard Marker Projection Computer	Determine a determine the minors and cofactors 2 by 2 and 3	Guide students to: Determine a determine the minors and	

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	matrixes e.g.: • Zero matrix • Identity matrix • Square matrix • Triangular matrix • Symmetric matrix. 4.3 State examples for each of the matrixes in 4.2 above 4.4 State the laws of addition and multiplication of matrixes. 4.5 Illustrate the commutative, associative and distributive nature of the laws stated in 4.4 above. 4.6 Define the transpose of a matrix.	matrixes e.g.: • Zero matrix • Identity matrix • Square matrix • Triangular matrix • Symmetric matrix. Explain examples for each of the matrixes in 4.2 above Explain the laws of addition and multiplication of matrixes. Explain the commutative, associative and distributive nature of the laws stated in 4.4 above. Explain the transpose of a matrix.	Internet Textbooks Lecture Notes	by 3 matrixes State and prove the theorem "if two rows or two columns of a matrix are interchanged, the sign of the Value of its determinant is changed Identify the minors and cofactors of a determinant Identify the method of evaluating determinants.	cofactors 2 by 2 and 3 by 3 matrixes State and prove the theorem "if two rows or two columns of a matrix are interchanged, the sign of the Value of its determinant is changed Identify the minors and cofactors of a determinant Identify the method of evaluating determinants.	

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	4.7 Determine the minors and cofactors 2 by 2 and 3 by 3 matrixes 4.8 Define the minors and cofactors of a determinants 4.9 Explain the method of evaluating determinants. 4.10 State and prove the theorem “two rows or two columns of a matrix are identical, and then the value of its determinant is zero”. 4.11 State and prove the theorem “if two rows or two columns of a matrix are interchanged, the sign of the Value of its determinant is changed	Explain the minors and cofactors 2 by 2 and 3 by 3 matrixes Explain the minors and cofactors of a determinants Explain the method of evaluating determinants. Explain and prove the theorem “two rows or two columns of a matrix are identical, and then the value of its determinant is zero”. Explain and prove the theorem “if two rows or two columns of a matrix are interchanged, the sign of the Value of its determinant is changed				

EVALUATION- EXAMINATION: 40% C.A : 60%

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Electrical Power II

PROGRAMME: NATIONAL DIPLOMA IN ELECTRICAL AND ELECTRONICS ENGINEERING TECHNOLOGY		
COURSE TITLE: Electrical Power II	**COURSE CODE:** EEC 211	**CONTACT HOURS:** 3
	CREDIT UNIT: 2	**THEORETICAL:** 1
YEAR: II **SEMESTER:** I	**PRE-REQUISITE:** EEC 121	**PRACTICAL:** 2
GOAL: This course is designed to acquaint the students with the knowledge and skills of the principles of power system		
GENERAL OBJECTIVES: On completion of this course, the student should be able to: 1.0 Understand other methods of Electricity Generation 2.0 Understand the transmission lines and cable 3.0 Understand the performance of short, medium and long transmission lines.		

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PROGRAMME: NATIONAL DIPLOMA IN ELECTRICAL AND ELECTRONICS ENGINEERING TECHNOLOGY					
COURSE TITLE: Electrical Power II	**COURSE CODE:** EEC 211			**CONTACT HOURS:** 3	
	CREDIT UNIT: 2			**THEORETICAL:** 1	
YEAR: II **SEMESTER:** I	**PRE-REQUISITE:** EEC 121			**PRACTICAL:** 2	
COURSE SPECIFICATION: THEORETICAL AND PRACTICAL					
GOAL: This course is designed to acquaint the students with the knowledge and skills of the principles of power systems					
GENERAL OBJECTIVE 1.0: Understand other methods of Electricity Generation					
THEORETICAL CONTENT				**PRACTICAL CONTENT**	
Week	**Specific Learning Outcome**	**Teachers' Activities**	**Resources**	**Specific Learning Outcome**	**Teachers' Activities**	**Resources**
1-6	1.1 Describe the following: • Hydro electricity • Generation plant. • Magneto- Hydro-Dynamic (MHD) power plant • Combine cycle Gas power plant. • Biomass power plant. • PV power plant • Wind power plant.	Explain the following: • Hydro electricity • Generation plant. • Magneto-Hydro-Dynamic (MHD) power plant • Combine cycle Gas power plant. • Biomass power plant. • PV power plant • Wind power plant.	Textbooks Journals White board Marker Charts Animations Computer Projector	Visit a power plant Demonstrate the layout diagrams of power plants Assemble the components of the PV Power generation system for domestic application.	Guide the students to: Visit a power plant Demonstrate the layout diagrams of power plants Assemble the components of the PV Power	Chart of the Nigerian National Grid system PV panel Charge controller Battery storage

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	1.2 Explain the factors affecting the choice of site for plants in 1.1 above 1.3 Explain the advantages and disadvantages of power plants in 1.1 1.4 Explain a typical layout of a power generation system. 1.5 Describe the Nigerian National Electric Power Grid system. 1.6 Describe a microgrid and state its benefits and challenges 1.7 Describe Renewable Energy Sources (RES)	Explain the factors affecting the choice of site for plants in 1.1 above Explain the advantages and disadvantages of power plants in 1.1 Explain a typical layout of a power generation system. Explain the Nigerian National Electric Power Grid system. Explain a microgrid and state its benefits and challenges		Draw a typical load curve	generation system for domestic application. Draw a typical load curve	Inverter and energy saver lamp Connecting cable Switch Fuse and junction box.

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	with their benefits and challenges. 1.8 Describe the layout of the PV Power generation system and its application 1.9 Describe the layout of the wind power generation system and its applications. 1.10 Describe the types of generators that are commonly used for peak, medium and base loads. 1.11Explain how to calculate load factor, peak and base load costs in the distribution system applying per unit.	Explain Renewable Energy Sources (RES) with their benefits and challenges. Explain the layout of the PV Power generation system and its application Explain the layout of the wind power generation system and its applications. Explain the types of generators that are commonly used for peak, medium and base loads.				

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	1.12 Explain a typical load curve.	Explain how to calculate load factor, peak and base load costs in the distribution system applying per unit. Explain a typical load curve.				
General Objective 2.0: Understand the transmission lines and cable						
7-11	2.1 Describe types of: • Poles • Pole support • Insulators • Towers. 2.2 Describe the line and route surveying. 2.3 Derive expressions for resistance, inductance and capacitance for transmission lines. 2.4 Explain the short,	Explain types of: • Poles • Pole support • Insulators • Towers. Explain the line and route surveying Explain the derivation of resistance, inductance and capacitance for transmission lines. Explain the short,	Textbooks Journals White board Marker, Charts and animations Computer Projector	Visit a transmission substations Assemble poles, pole supports, and insulators in a dead substation. Connect voltage and current transformers for measurements in the transmission line model.	Guide students to: Visit a transmission substations Assemble poles, pole supports, insulators, and towers in a dead substation Connect voltage and current transformers for measurements in	Samples of poles Pole supports Towers Chart for construction of various conductors and cables Transmission

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	medium and long transmission models. 2.5 Explain problems involved in short and medium transmission lines. 2.6 Describe the applications of voltage and current transformers in the transmission line. 2.7 Describe with the aid of diagrams, the construction of various conductors and their sizes. 2.8 Describe with the aid of diagrams the construction of types of underground cables and their advantages. • Two-core cable • Three core cable	medium and long transmission models Explain problems involved in short and medium transmission lines. Explain the applications of voltage and current transformers in the transmission line. Explain with the aid of diagrams, the construction of various conductors and their sizes. Explain with the aid of diagrams the construction of various types of under ground cable and state	.`	Demonstrate the stages of construction for conductors and laying underground cables: Two-core cable Three core cable	model. Demonstrate the stages of construction for conductors and laying underground cables: Two-core cable Three core cable	and distribution line trainer Video clips

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	2.9 Define dielectric stress and ionization in cables. 2.10 Derive expression for the capacitance dielectric stress, insulation resistance and resistivity of a single core cable. 2.11 State expression for the thermal resistance for single and three-core cables.	their advantages • Two-core cable • Three core cable Explain dielectric stress and ionization in cables Explain the expression for the capacitance dielectric stress, insulation resistance, and resistivity of a single-core cable. Explain the expression for the thermal resistance for single and three-core cables.				
General Objective 3.0: Understand the performance of short, medium and long transmission lines.						

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12-15	3.1 Describe the principles of modeling of short and medium transmission lines. 3.2 Describe the concept of per unit system. 3.3 Describe the expressions for per unit power, voltage, current and impedance. 3.4 Describe the voltage at the sending end and receiving end of the transmission line. 3.5 Describe the phasor diagram of a short transmission line. 3.6 Explain and solve problems in short	Explain the modeling of short and medium transmission lines. Explain the concept of per unit system. Explain expressions for per unit power, voltage, current and impedance. Explain the voltage at the sending and receiving end of a transmission line. Explain the phasor diagram of a short transmission line	Textbooks Journals White board Marker Charts Animations Computer Projector			

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	transmission lines for voltage drop, voltage regulation, transmission efficiency and copper losses. 3.7 Explain the approximate equivalent diagrams for nominal Π (Pi) and nominal T networks and calculate the parameters. 3.8 Describe the phasor diagrams for nominal Π (Pi) or nominal T network systems.	Explain and solve problems in voltage drop, voltage regulation, transmission efficiency and copper losses in a transmission line. Explain the approximate equivalent diagrams for nominal Π (Pi) and nominal (T) networks and calculate the parameters. Explain the phasor diagrams for nominal Π (Pi) or nominal T network systems.				
ASSESSMENT: The practical class will be awarded 60% of the total score. The continuous assessments, test and quizzes will take 10% of the total score, while the remaining 30% will be for the end of the semester examination score.						

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Electrical Machine II

PROGRAMME: NATIONAL DIPLOMA IN ELECTRICAL AND ELECTRONICS ENGINEERING TECHNOLOGY		
COURSE TITLE: Electrical Machine II	**COURSE CODE:** EEC 212	**CONTACT HOURS:** 3
	CREDIT UNIT: 2	**THEORETICAL:** 1
YEAR: II **SEMESTER:** I	**PRE-REQUISITE:** EEC 122	**PRACTICAL:** 2
GOAL: This course is designed to equip the student with the knowledge and skills of the principles of operations, construction and maintenance of electrical machines		
GENERAL OBJECTIVES: On completion of this course, the student should be able to: 1.0 Understand the fundamental principles of electrical machines. 2.0 Understand the principles of electro-mechanical energy conversion. 3.0 Know the principles of operation and construction of transformers.		

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PROGRAMME: NATIONAL DIPLOMA IN IN ELECTRICAL AND ELECTRONICS ENGINEERING TECHNOLOGY		
COURSE TITLE: Electrical Machine II	**COURSE CODE:** EEC 212	**CONTACT HOURS:** 3
	CREDIT UNIT: 2	**THEORETICAL:** 1
YEAR: II **SEMESTER:** I	**PRE-REQUISITE:** EEC 122	**PRACTICAL:** 2
COURSE SPECIFICATION: THEORETICAL AND PRACTICAL		
GOAL: This course is designed to equip the student with the knowledge and skills of the principles of operations, construction and maintenance of electrical machines		
General Objectives 1.0: Understand the fundamental principles of electrical machines		

THEORETICAL CONTENT				**PRACTICAL CONTENT**		
Week	**Specific Learning Outcome**	**Teachers' Activities**	**Resources**	**Specific Learning Outcome**	**Teachers' Activities**	**Resources**
1 – 5	1.1 Describe basic principles of electrical machine 1.2 Describe the principle of: • Induction • Alignment • Interaction • Rotating magnetic field 1.3 Describe with the aid of sketches how the principles are applied to electrical	Explain basic principles of electrical machine Explain the principle of: • Induction • Alignment • Interaction • Rotating magnetic field Explain with the aid of sketches how the principles are applied to electrical machines	Textbooks Journals White board, Marker Charts Animations Computer Projector	Carryout experiments on circuit characteristics of a 3-phase induction motor. Carryout experiment on circuit characteristics of an alternator/A.C generator. Perform experiment to determine relationship between excitation current and output	Guide the students to: Carryout experiments on circuit characteristics of a 3-phase induction motor. Carryout experiment on circuit characteristics of an alternator/A.C generator. Perform experiment to determine relationship between excitation current and output	Electrical machine Starter Voltmeter Ammeter Tachometer Phase sequence indicator/meter.

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	machines. 1.4 Describe Electro – mechanical energy conversion.	Explain Electro – mechanical energy conversion.		terminal voltage Perform experiment to determine relationship between speed and output terminal voltage. Demonstrate the construction of electrical machines.	terminal voltage Perform experiment to determine relationship between speed and output terminal voltage. Demonstrate the construction of electrical machines	
General Objective 2.0: Understand the principles of electro-mechanical energy conversion						
6 – 10	2.1 Describe the construction and principle of Induction motor. 2.2 Describe the principle of operation of synchronous generator and motors. 2.3 Describe Stator and Rotor construction as applied to synchronous machine.	Explain the construction and principle of Induction motor. Describe the principle of operation of synchronous generator and motors. Describe Stator and Rotor construction as applied to synchronous machine. Explain the major	Textbooks Journals Whiteboard Marker Charts Animations Computer Projector	Interpret name plate of synchronous and induction motors and generators Demonstrate the conversion of energy in singly excited systems. Determine the terminal of a 3 – phase induction motor	Guide the students to: Interpret name plate of synchronous and induction motors and generators Demonstrate the conversion of energy in singly excited systems. Determine the terminal of a 3 – phase induction motor	Sample name plates Electrical machine Starters Generator Induction motor Synchronous motor

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	2.4 State the major energy conversion principles. 2.5 Derive the energy in the magnetic field of a singly excited system. 2.6 State the need for control and protection of electric motors 2.7 Describe the techniques for motor starting and control: • Direct online starter • Star-Delta starter • Auto Transformer • Part winding • Soft starter • Variable frequency drive	energy conversion principles. Explain how to derive the energy in the magnetic field of a singly excited system. State the need for control and protection of electric motors Describe the techniques for motor starting and control: • Direct online starter • Star-Delta starter • Auto Transformer • Part winding • Soft starter • Variable frequency drive Describe the types of		Determine the terminal of a 3 – phase synchronous generator. Measure the electrical quantities of 3 phase induction motor. Identify the basic difference between motors and generators. Demonstrate the techniques for motor starting and control: • Direct online starter • Star-Delta starter • Soft starter • Variable frequency drive	Determine the terminal of a 3 – phase synchronous generator. Measure the electrical quantities of 3 phase induction motor. Identify the basic difference between motors and generators. Demonstrate the techniques for motor starting and control: • Direct online starter • Star-Delta starter • Soft starter • Variable frequency drive	Ammeter Voltmeter Clamp meter Tachometer Multimeter.

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	2.8 Describe the types of overcurrent protective devices	overcurrent protective devices				
General Objective 3.0: Know the principles of operation and construction of transformers.						
11–15	3.1 Define transformer 3.2 Explain the classification of transformers 3.3 Explain the applications of transformer 3.4 Differentiate between power and distribution transformers. 3.5 Describe the effects of temperature rise on transformers. 3.6 Describe the different types of transformer	Explain transformers Explain the classification of transformers Explain the applications of transformer Explain the differences between power and distribution transformers. Explain the effects of temperature rise on transformers. Explain the different	Textbooks Journals White board Marker Charts Animations Computer Projector Electrical machines	Visit power substation/show video clips Classify transformers Monitor temperature of a transformer. Identify methods of cooling transformers. Sketch phasor diagrams of transformers on load and on No-load Sketch the equivalent circuit of a transformer Perform experiment on open circuit characteristics of a single	Guide students to: Visit power substation/ show video clips Classify transformers Monitor temperature of a transformer. Identify methods of cooling transformers. Sketch phasor diagrams of transformers on load and on No-load Sketch the equivalent circuit of a transformer Perform experiment on open circuit	Transformer Ammeter, Voltmeter, Clamp meter, Tachometer, Multimeter Temperature Sensors, . Video clips

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	cores and windings. 3.7 Describe methods of cooling transformers. 3.8 Describe the limitation of each method. 3.9 Explain the working principle of the transformers. 3.10 Derive the EMF equation of a transformer. 3.11 Describe: • Resultant flux • Magnetizing inductance • Leakage fluxes • Leakage inductances. 3.12 Describe the phasor diagrams for transformer on No-	types of transformer cores and windings. Explain methods of cooling transformers. Explain the limitations of each method. Explain the working principle of the transformers. Explain the EMF equation of a transformer. Describe: • Resultant flux • Magnetizing inductance • Leakage fluxes • Leakage inductances. Describe the phasor		phase transformer. Perform experiment on open circuit characteristics of three phase transformers. Carryout experiment on close circuit characteristics of a single phase transformer. Perform experiment on close circuit characteristics of three phase transformer. Perform experiment on identifying polarity of a 3-phase transformer. Conduct transformation ration test on a transformer’	characteristics of a single phase transformer. Perform experiment on open circuit characteristics of three phase transformers. Carryout experiment on close circuit characteristics of a single phase transformer. Perform experiment on close circuit characteristics of three phase transformer. Perform experiment on identifying polarity of a 3-phase transformer. Conduct transformation ration test on a transformer’	

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	load and On-load. 3.13 Describe the equivalent circuit of a transformer. 3.14 Explain the limitations of the equivalent circuit and the approximate equivalent circuit. 3.15 Explain Open-circuit and the Short-circuit tests to determine the equivalent circuit parameters. 3.16 Describe different methods of testing transformers. 3.17 Describe connection of three single phase transformers for 3-phase operation (i.e. Star/Star, Star/Delta).	diagrams for transformer on No-load and On-load. Describe the equivalent circuit of a transformer. Explain the limitations of the equivalent circuit and the approximate equivalent circuit. Explain Open-circuit and the Short-circuit tests to determine the equivalent circuit parameters. Describe different methods of testing transformers. Explain connection of three single phase transformers for 3-phase operation (i.e.		Use the Open-circuit and Short-circuit tests to determine the equivalent circuit parameters. Sketch possible arrangement of three transformer windings.	Use the Open-circuit and Short-circuit tests to determine the equivalent circuit parameters. Sketch possible arrangement of three transformer windings.	

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		Star/Star, Star/Delta).				
	3.18 Describe diagrammatically the possible arrangement of three transformer windings.	Explain diagrammatically the possible arrangement of three transformer windings.				
	3.19 Describe the purpose of the tertiary windings in 3-phase transformers.	Explain the purpose of the tertiary windings in 3-phase transformers.				
	3.20 Describe the parallel operation of 3-phase transformers.	Explain the parallel operation of 3-phase transformers.				
	3.21 State the conditions for paralleling of transformers	Explain the conditions for paralleling of transformers				
	3.22 Derive expression for load sharing of transformers connected in parallel.	Explain how to derive expression for load sharing of transformers connected in parallel.				
Assessment: The practical class will be awarded 60% of the total score. The continuous assessments, test and quizzes will take 10% of the total score, while the remaining 30% will be for the end of the semester examination score.						

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PROGRAMME: NATIONAL DIPLOMA IN ELECTRICAL AND ELECTRONICS ENGINEERING TECHNOLOGY		
COURSE TITLE: Electronics II	**CODE:** EEC 213	**CONTACT HOURS:** 4
	CREDIT UNIT: 3	**THEORETICAL:** 1
YEAR: II **SEMESTER:** I	**PRE-REQUISITE:** EEC 123	**PRACTICAL:** 3
GOAL: This course is designed to equip the student with the knowledge and skills of passive and active electronic components and their applications.		
GENERAL OBJECTIVES: At the end of the course the student should be able to: 1.0 Understand Field Effect transistor and its applications 2.0 Understand biasing equivalent circuits and gain stages 3.0 Understand transformer coupling and power and multistage of amplifiers		

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Electronics II

PROGRAMME: NATIONAL DIPLOMA IN ELECTRICAL AND ELECTRONICS ENGINEERING		
COURSE TITLE: Electronics II	**CODE:** EEC 213	**CONTACT HOURS:** 4
	CREDIT UNIT: 3	**THEORETICAL:** 1
YEAR: II **SEMESTER:** I	**PRE-REQUISITE:** EEC 123	**PRACTICAL:** 3
COURSE SPECIFICATION: THEORETICAL AND PRACTICAL		
GOAL: This course is designed to equip the student with the knowledge and skills of semi-conductor components		
General Objective 1.0 : Understand the Field Effect transistor and its applications		

THEORETICAL CONTENT				**PRACTICAL CONTENT**		
Week	**Specific Learning Outcome**	**Teachers' Activities**	**Resources**	**Specific Learning Outcome**	**Teachers' Activities**	**Resources**
1 -5	1.1 Describe the basic operations and constructional features of FET's (junction gate and insulated gate). 1.2 Explain JFET Transfer Characteristics. 1.3 Describe Mutual Conductance and Drain to Source Resistance. 1.4 Describe handling precautions of FET.	Explain the basic operations and constructional features of FETs (junction gate and insulated gate). Explain the transfer Characteristics of JFET Explain Mutual Conductance and Drain to Source Resistance Explain handling	Textbooks Journals Whiteboard Marker Charts Animations Computer Projector	Carry out experiment on FET Static Characteristics in common source configuration Demonstrate the applications of MOSFET: • Switching (DC-DC Converter) • Amplification • Variable resistance (Signal processing)	Guide students to: Carry out experiment on FET Static Characteristics in common source configuration Demonstrate the applications of MOSFET: • Switching (DC-DC Converter) • Amplification • Variable resistance (Signal processing)	Breadboard MOSFET Multimeter FET JFET

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	1.5. Define Input Resistance. 1.6 Describe Depletion mode and enhancement mode of MOSFET Characteristics. 1.7 Explain the applications of FET, JFET and MOSFET	precautions of FET Explain Input Resistance Explain Depletion mode and enhancement mode of MOSFET Characteristics Explain the applications of FET, JFET and MOSFET				
General Objective 2.0: Understand the biasing equivalent circuits and gain stages						
6 - 10	2.1 Describe DC Biasing and r – parameters. 2.2 Describe Common source Configuration of MOSFET • Voltage gain • Current Gain • Power Gain. 2.3 Describe Common drain Configuration of	Explain DC biasing and r – parameters. Explain Common source Configuration of MOSFET • Voltage gain • Current Gain • Power Gain. Explain Common drain Configuration of	Textbooks Journals Whiteboard marker Charts Animations Computer Projector	Perform experiment on common source amplifier characteristics. Carry Out experiment on common gate amplifier characteristics Conduct an experiment on common drain amplifier characteristics	Guide students to: Perform experiment on common source amplifier characteristics. Carry Out experiment on common gate amplifier characteristics Conduct an experiment on common drain	Breadboard, MOSFET, Multimeter, DC Power source.

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	MOSFET • Voltage gain • Current gain • Power gain 2.4 Describe Common gate Configuration of MOSFET • Voltage gain • Current gain • Power gain 2.5 Differentiate between the configurations of BJT and MOSFET	MOSFET. • Voltage gain • Current gain • Power gain Explain Common gate Configuration of MOSFET • Voltage gain • Current gain • Power gain Explain the differences between the configurations of BJT and MOSFET			amplifier characteristics	
General Objective 3.0: Understand the Transformer coupling and power and multistage of amplifiers**.**						
11-15	3.1 Describe Power amplifier 3.2 Explain transformer coupling. 3.3 Describe principles of coupling 3.4 Explain the methods of	Explain Power amplifier Explain transformer coupling. Explain principles of coupling Explain the methods of	Textbooks Journals Whiteboard marker Charts Animations Computer Projector	Perform an experiment on Characteristics of transformer coupled Class A amplifier: Identify the frequency response characteristics of amplifier.	Guide students to: Perform an experiment on Characteristics of transformer coupled Class A amplifier: Identify the frequency response characteristics of amplifier.	Transformer coupled Class Amplifier Multimeter Oscilloscope Electronics

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	inter stage coupling in multistage amplifiers. 3.3 Describe Amplifiers and small signal analysis. 3.4 Describe multistage amplifiers. 3.6 Describe Complex amplifier circuit.	inter stage coupling in multistage amplifiers. Explain Amplifiers and small signal analysis. Explain multistage amplifiers. Explain Complex amplifier circuit.		Identify the relationship impedance, power and phase relationship.	Identify the relationship impedance, power and phase	trainer Circuit construction deck Semiconductor trainer.
Assessment: The practical class will be awarded 60% of the total score. The continuous assessments, test and quizzes will take 10% of the total score, while the remaining 30% will be for the end of the semester examination score.						

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Electric Circuit Theory I

PROGRAMME: NATIONAL DIPLOMA IN ELECTRICAL AND ELECTRONICS ENGINEERING TECHNOLOGY		
COURSE TITLE: Electric Circuit Theory I	**COURSE CODE:** EEC 214	**CONTACT HOURS:** 3
	CREDIT UNIT: 2	**THEORETICAL:** 1
YEAR: II **SEMESTER:** I	**PRE-REQUISITE:**	**PRACTICAL:** 2
GOAL: This course is designed to equip the students with knowledge and skills of electrical circuit theorems and network analysis of multiphase systems**.**		
GENERAL OBJECTIVES: On completion of this course, the student should be able to: 1.0 Understand a.c theory and its applications in simple electrical circuits. 2.0 Know mesh and nodal analysis and their applications in solving electrical circuits' problems. 3.0 Understand network transformation and duality principles. 4.0 Understand network theorems and their applications to d.c and a.c circuits.		

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PROGRAMME: NATIONAL DIPLOMA IN ELECTRICAL AND ELECTRONIC ENGINEERING TECHNOLOGY						
COURSE TITLE: Electric Circuit Theory I		**COURSE CODE:** EEC 214		**CONTACT HOURS:** 3		
		CREDIT UNIT: 2		**THEORETICAL:** 1		
YEAR: II **SEMESTER:** I		**PRE-REQUISITE:**		**PRACTICAL:** 2		
COURSE SPECIFICATION: THEORETICAL AND PRACTICAL						
GOAL: This course is designed to equip the students with knowledge and skills of electrical circuit theorems and network analysis of multiphase systems.						
General Objective 1.0: Understand a.c theory and its applications in simple electrical circuits.						
THEORETICAL CONTENT				**PRACTICAL CONTENT**		
Week	**Specific Learning Outcome**	**Teachers' Activities**	**Resources**	**Specific Learning Outcome**	**Teachers' Activities**	**Resources**
1 - 4	1.1 Define signals 1.2 Explain the types of signals 1.3 State the different mathematical forms of representing a.c signals. such as: • Exponential • Trigonometry • Polar • Rectangular (j-notation) 1.4 Explain how to convert a.c signal in	Explain signals Explain the types of signals Explain the different mathematical forms of representing a.c signals such as: • Exponential • Trigonometry • Polar and • Rectangular (j-notation)	Textbooks Journals Markers Whiteboard Charts Animation Calculators Computer Multimedia Projectors	Draw to scale phasor diagrams for a.c circuits. Draw phasor diagrams that the current in a capacitor circuit leads voltage and the current in the inductive circuit lags the voltage. Investigate the behaviour of series-	Guide students to: Draw to scale phasor diagrams for a.c circuits. Draw phasor diagrams that the current in a capacitor circuit leads voltage and the current in the inductive circuit lags the voltage. Investigate the behaviour of series-	Sample phasor diagrams Electrical circuits Ohmmeter Capacitor Multimeter Electronic trainer

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	polar form to the Rectangular form. 1.5 Explain how to use all the four (4) mathematical operator to calculate the values of ac signals in different forms of ac signal. 1.6 Solve simple problems using j-notation 1.7 Explain with the aid of phasor diagrams (draw to scale) the behaviour of a.c 1.8 Distinguish between inductive reactance and capacitive reactance. 1.9 Define a.c Circuits 1.10 Explain the types of a.c circuits	Explain how to convert a.c signal in polar form to the Rectangular form. Explain how to use all the four (4) mathematical operator to calculate the values of ac signals in different forms of ac signal. Explain how to solve as many numerical problems as possible on conversion of an ac signals from one form to another. Explain with the aid of phasor diagrams (draw to scale) the behaviour of a.c Explain the difference between inductive reactance and capacitive reactance. Explain a.c circuits and its types		parallel connected resistors. Determine the voltage divider. Test the inductor using ohmmeter. Demonstrate how to test capacitor by observing their charging and discharging Convert a.c signal in polar form to the Rectangular form. Demonstrate how to verify Ohm‘s law. Simulate resonance conditions in series and parallel RLC circuits. Show with the aid of phasor diagrams that the current in a capacitor circuit leads voltage and the	parallel connected resistors. Determine the voltage divider. Test the inductor using ohmmeter. Demonstrate how to test capacitor by observing their charging and discharging Convert a.c signal in polar form to the Rectangular form. Demonstrate how to verify Ohm‘s law. Simulate resonance conditions in series and parallel RLC circuits. Show with the aid of phasor diagrams that the current in a capacitor circuit	

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	1.11 Explain how to draw the phasor diagrams for series and parallel a.c circuits. 1.12 Explain how to calculate voltage, current, power and power factor in series and parallel circuits. 1.13 Explain series and parallel resonance 1.14 Explain how to calculate the Q-factor for a coil; loss factor for a capacitor. 1.15 Explain, with the aid of a diagram, bandwidth 1.16 Explain how to solve problems involving bandwidth and circuit Q-factor. 1.17 Explain resonance in RLC circuit	Explain the types of a.c circuits Explain how to draw the phasor diagrams for series and parallel a.c circuits. Explain how to calculate voltage, current, power and power factor in series and parallel circuits. Explain the resonance frequency and the conditions for series and parallel resonance. Explain how to calculate the Q-factor for a coil; loss factor for a capacitor. Explain, with the aid of a diagram, bandwidth Explain how to solve problems involving bandwidth and circuit Q-factor.		current in the inductive circuit lags the voltage. Show wave forms of lagging and leading angles of voltage and current on a Cartesian plane.	leads voltage and the current in the inductive circuit lags the voltage. Show wave forms of lagging and leading angles of voltage and current on a Cartesian plane.	

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		Explain resonance in RLC circuit				
General Objective 2.0: Know mesh and nodal analysis and their applications in solving electrical circuits problems						
5 – 7	2.1 Explain the terms used in electric network: • Ideal and practical independent current and voltage sources • Branch • Node • Loop • Network 2.2 Explain the basic principle of mesh circuit analysis. 2.3 Explain how to solve problem on mesh circuit analysis. 2.4 Explain the basic principle of nodal circuit analysis. 2.5 Explain how to solve	Explain the terms used in electric network: • Ideal and practical independent current and voltage sources • Branch • Node • Loop • Network Explain the basic principle of mesh circuit analysis and nodal analysis Explain how to solve problem on mesh circuit analysis Explain the basic principle of nodal circuit analysis. Explain how to solve as many numerical problems as	Textbooks Journals Markers Whiteboard Charts Animation Calculators Computer Multimedia Projectors	Demonstrate the application of mesh circuit analysis. Demonstrate the application of Nodal circuit analysis.	Guide students to: Demonstrate the application of mesh circuit analysis. Demonstrate the application of Nodal circuit analysis.	Sample phasor diagrams Electrical circuits Ohmmeter Capacitor Multimeter Electronic trainer

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	problems on nodal circuit analysis.	possible on mesh and nodal circuit analysis.				
General Objective 3.0: Understand network transformation and duality principles						
8–11	3.1 Explain network transformation 3.2 Explain how to reduce a complex network to its series or parallel equivalent. 3.3 Explain star and delta networks. 3.4 Explain how to derive the formula for the transformation of a delta to a star network and vice versa. 3.5 Explain duality principle. 3.6 Explain duality between resistance, conductance inductance, capacitance,	Explain network transformation Explain the process of reducing a complex network to its series or parallel equivalent Explain Star and Delta networks Explain how to derive formula for the transformation of a Delta to Star network and vice versa. Explain duality principle. Explain how to establish duality between resistance, conductance inductance, capacitance, voltage- current	Textbooks Journals Markers Whiteboard Charts Animation. Calculators Computer Multimedia Projectors	Reduce a complex network to its series or parallel equivalent. Derive the formula for the transformation of a delta to a star network and vice versa. Measure the total resistance of combinations of parallel connected resistors. Determine by experiment the total resistance of resistors connected in series.	Guide students to: Reduce a complex network to its series or parallel equivalent. Derive the formula for the transformation of a delta to a star network and vice versa. Measure the total resistance of combinations of parallel connected resistors. Determine by experiment the total resistance of resistors connected in series.	Sample phasor diagrams Electrical circuits Ohmmeter Capacitor Multimeter Electronic trainer

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	voltage- current			Identify star and delta networks	Identify star and delta networks	
General Objective 4.0: Understand network theorems and their applications to d.c and a.c circuits						
12 -15	4.1 State Thevenin's Theorem. 4.2 Explain the basic principle of Thevenin's theorem. 4.3 Solve problems on some network using Thevenin's theorem. 4.4 State Norton's theorem. 4.5 Explain the basic principle of Norton's theorem. 4.6 State the difference between the Norton's theorem and Thevenin's theorem. 4.7 Explain how to solve problems using	Explain Thevenin's Theorem. Explain the basic principle of Thevenin's theorem. Explain problems on some network using Thevenin's theorem. Explain Norton's theorem. Explain the basic principle of Norton's theorem. Explain the difference between the Norton's theorem and Thevenin's theorem. Explain how to solve problems using Norton's	Textbooks Journals Markers Whiteboard Charts Animation. Calculators Computer Multimedia projectors	Verify Thevenin's theorem. Demonstrate the application of Nodal circuit analysis. Verify the Millman's theorem Use Thevenin's theorem to analyze energy delivery from a battery to a load.	Guide students to: Verify Thevenin's theorem. Demonstrate the application of Nodal circuit analysis. Verify the Millman's theorem Use Thevenin's theorem to analyze energy delivery from a battery to a load.	Sample phasor diagrams Electrical circuits Ohmmeter Capacitor Multimeter Electronic trainer

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	Norton's theorem. 4.8 State Millman's theorem. 4.9 Explain the basic principle of Millman's theorem. 4.10 Explain how to solve network problems using Millman's theorem. 4.12 State Reciprocity theorem 4.13 Explain the basic principle of reciprocity theorem 4.14 Explain how to solve network problems using Reciprocity theorem. 4.15 Explain the Thevenin's and	theorem. Explain Millman's theorem. Explain the basic principle of Millman's theorem. Explain how to solve network problems using Millman's theorem. Explain Reciprocity theorem Explain the basic principle of reciprocity theorem Explain how to solve network problems using Reciprocity theorem. Explain the Thevenin's and Norton's theorem to solve electric circuits/networks				

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	Norton's theorem to solve electric circuits/networks problems 4.16 Explain how to solve network problems using Millman's theorem and Reciprocity theorem	problems Explain how to solve network problems using Millman's theorem and Reciprocity theorem				
EVALUATION: The practical class will be awarded 60% of the total score. The continuous assessments, test and quizzes will take 10% of the total score, while the remaining 30% will be for the end of semester examination score.						

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Use of Electrical and Electronics Instrument

PROGRAMME: NATIONAL DIPLOMA IN ELECTRICAL AND ELECTRONICS ENGINEERING TECHNOLOGY		
COURSE TITLE: Use of Electrical and Electronics Instrument	**COURSE CODE:** EEC 215	**CONTACT HOURS:** 3
	CREDIT UNIT: 2	**THEORETICAL:** 1
YEAR: II **SEMESTER:** I	**PRE-REQUISITE:** EEC 125	**PRACTICAL:** 2
GOAL: This course is designed to acquaint the students with the knowledge and skills of application of electrical/electronic instruments for laboratory and industrial measurements		

GENERAL OBJECTIVES:

At the end of the course the student should be able to:

1.0 Understand an oscilloscope.

2.0 Understand the operation of power meter

3.0 Understand the factors for selection of electrical and electronic instruments.

4.0 Understand the importance of electrical instruments in industries

5.0 Understand controllers and controller design (Proportional Integral Derivative, PID)

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PROGRAMME: NATIONAL DIPLOMA IN ELECTRICAL AND ELECTRONICS ENGINEERING TECHNOLOGY						
COURSE TITLE: Use of Electrical and Electronics Instruments		**COURSE CODE:** EEC 215		**CONTACT HOURS:** 3		
		CREDIT UNIT: 2		**THEORETICAL:** 1		
YEAR: II **SEMESTER:** I		**PRE-REQUISITE:** EEC 125		**PRACTICAL:** 2		
COURSE SPECIFICATION: THEORETICAL AND PRACTICAL						
GOAL: This course is designed to acquaint the students with the knowledge and skills of application of electrical/electronic instruments for laboratory and industrial measurements						
GENERAL OBJECTIVE: 1.0 Understand an Oscilloscope.						
THEORETICAL CONTENT				**PRACTICAL CONTENT**		
Week	**Specific Learning Outcome**	**Teachers' Activities**	**Resources**	**Specific Learning Outcome**	**Teachers' Activities**	**Resources**
1- 4	1.1 Explain the block diagram of an Oscilloscope 1.2 Explain the function of each block and the knobs 1.3 Explain the operation principles of an OSCILLOSCOPE	Explain the block diagram of an Oscilloscope Explain the function of each block and the knobs Explain the operation principles of an OSCILLOSCOPE	Textbooks Journals Whiteboard Marker Charts Animations Computer Projector	Draw the block diagram of an Oscilloscope Measure D.C voltage in experiments using OSCILLOSCOPE Measure A.C voltage in experiments using OSCILLOSCOPE Measure range of frequencies with OSCILLOSCOPE	Guide Students to: Draw the block diagram of an Oscilloscope Measure D.C voltage in experiments using OSCILLOSCOPE Measure A.C voltage in experiments using OSCILLOSCOPE Measure range of frequencies with	OSCILLOSCOPE Signal generator DC/AC power supplies and probe OSCILLOSCOPE and OSCILLOSCOPE charts.

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				Measure phase angles with OSCILLOSCOPE	OSCILLOSCOPE Measure phase angles with OSCILLOSCOPE	
General Objective 2.0: Understand the operation of power meter.						
5-7	2.1 Define Power meter 2.2 Explain the operation of the meter in 2.1 2.3 Explain the use of three meters and two meters in measuring power in three-phase Circuit 2.4 Explain how to calculate Power factor.	Explain Power meter Explain the operation of the meter in 2.1 Explain the use of three meters and two meters in measuring power in three-phase Circuit Explain how to calculate Power factor.	Textbooks Journals Whiteboard Marker Charts Animations Computer Projector	Sketch Power meter Measure DC and AC power Measure DC and AC power for single and three phase circuits Measure power factor	Guide the students to: Sketch Power meter Measure DC and AC power Measure DC and AC power for single and three phase circuits Measure power factor	Wattmeter Power supplies Single and three phase circuits charts.
General Objective 3.0: Understand the factors for selection of electrical and electronic instruments						
8-10	3.1 Define electrical and electronic instruments 3.2 Explain the factors to be considered when	Explain electrical and electronic instruments Explain the factors to be considered when	Textbooks Journals Whiteboard Marker Charts			

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	selecting electrical and electronic instruments: • Range • Accuracy • Response • Stability • Reliability • Sensitivity 3.3 Explain the importance of factors in 3.1 when selecting electrical and electronic instruments: • Range • Accuracy • Response • Stability • Reliability • Sensitivity	selecting electrical and electronic instruments: • Range • Accuracy • Response • Stability • Reliability • Sensitivity Explain the importance of the following factors in selecting electrical and electronic instruments: • Range • Accuracy • Response • Stability • Reliability • Sensitivity	Animations Computer Projector			
General Objective 4.0: Understand the importance of electrical instruments in industries						
11-12	4.1 Explain the following in relation to industries: • Conductor • Semiconductor • Diode	Explain the following in relation to industries: • Conductor • Semiconductor • Diode	Textbooks Journals Whiteboard Marker Charts Animations	Determine temperature effect on resistance	Guide students to: Determine temperature effect on resistance Verify temperature	Resistors Semi-conductor diodes Digital

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	• Temperature 4.2 Explain the electrical instruments used in industry 4.3 Explain the importance of measurement instruments in industry. 4.4 Explain the variables in 4.2 above 4.5 Explain the classification of instruments into the following: • Indicating • Recording • Controlling	• Temperature Explain the electrical instruments used in industry Explain the importance of measurement and instruments in industry Explain the variables in 4.2 above Explain the classification instruments into the following: • Indicating • Recording • Controlling	Computer Projector	Verify temperature effect on semiconductor diode Measure temperature range using digital thermometer	effect on semiconductor diode Measure temperature range using digital thermometer	thermometers Power supplies cables
General Objective 5.0 Understand controllers and controller design (Proportional Integral Derivative, PID)						
13-15	5.1 Define controllers 5.2 Explain the types of controllers	Explain controllers Explain the types of controllers	Textbooks Journals Whiteboard Marker Charts	Design a simple controller circuit	Guide students to: Design a simple controller circuit	Computers (with installed licensed Matlab or Python software

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	5.3 Explain the importance controllers to electronic circuits 5.4 Explain the properties of a Proportional, Integral and Derivative (PID) controller 5.5 Explain the uses of PID controller 5.6 Explain the circuits of PID controller in function generator and its uses in industries	Explain the importance controllers to electronic circuits Explain the properties of a Proportional, Integral and Derivative (PID) controller Explain the uses of PID controller Explain the circuits of PID controller in function generator and its uses in industries	Animations Computer Projector			PID controller
ASSESSMENT: The practical class will be awarded 60% of the total score. The continuous assessments, test and quizzes will take 10% of the total score, while the remaining 30% will be for the end of the semester examination score						

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Telecommunication II

PROGRAMME: NATIONAL DIPLOMA IN ELECTRICAL AND ELECTRONICS ENGINEERING TECHNOLOGY		
COURSE TITLE: Telecommunication II	**COURSE CODE:** EEC 216	**CONTACT HOURS:** 3
	CREDIT UNIT: 2	**THEORETICAL:** 1
YEAR: II **SEMESTER:** I	**PRE-REQUISITE:** EEC 126	**PRACTICAL:** 2
GOAL. This course is designed to equip the students with the knowledge and skills of the principles of telecommunication techniques		
GENERAL OBJECTIVES: On completion of this course, students should be able to:		

1.0 Know the basic principles of audio-visual (Television) signal transmission.
2.0 Know various frequency bands within the radio frequency spectrum.
3.0 Understand the principles of electromagnetic (EM) wave propagation.
4.0 Understand the principles of radio frequency (RF) wave propagation
5.0 Understand computer networks

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PROGRAMME: NATIONAL DIPLOMA IN ELECTRICAL AND ELECTRONICS ENGINEERING TECHNOLOGY						
COURSE TITLE: Telecommunication II		**COURSE CODE:** EEC 216		**CONTACT HOURS:** 3		
		CREDIT UNIT: 2		**THEORETICAL:** 1		
YEAR: II **SEMESTER:** I		**PRE-REQUISITE:** EEC 126		**PRACTICAL:** 2		
COURSE SPECIFICATION: THEORETICAL AND PRACTICAL						
GOAL: This course is designed to equip the students with the knowledge and skills of the principles of telecommunication techniques						
General Objective 1.0: Know the basic principles of audio-visual (Television) signal transmission						
THEORETICAL CONTENT				**PRACTICAL CONTENT**		
1 – 3	1.1 Explain signal transmission 1.2 Explain the principle of operation of television (TV) transmission. 1.3 Explain how vision and sound signals are generated separately and transmitted together 1.4 Explain the principle of operation of Radio frequency (RF) transmission.	Explain signal transmission Explain the principle of operation of television (TV) transmission. Explain how vision and sound signals are generated separately and transmitted together Explain the principle of operation of Radio frequency (RF) transmission. Explain digital transmission	Textbooks Journals Whiteboard Marker Charts Animations Computer Projector.	Demonstrate amplitude modulation with signals in audio frequency band. Demonstrate amplitude demodulation with AM modulated signal. Determine the frequency deviation with FM modulated signal.	Guide students to; Demonstrate amplitude modulation with signals in audio frequency band. Demonstrate amplitude demodulation with AM modulated signal. Determine the frequency deviation with FM modulated signal. Demonstrate the frequency demodulation with FM modulated signals.	TV sets, frequency generator AM and FM demonstration units Oscilloscope RF and AF demonstration units Receivers.

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	1.5 Explain digital transmission 1.6 Explain DTV standards and tools: • Terrestrial transmission • Satellite transmission • Cable transmission 1.7 Explain the features of digital transmission standards 1.8 Explain digital signals modulation 1.9 Explain types of digital signal modulation 1.10 Explain the basics of digital radio 1.11 Explain the principle of operation	Explain DTV standards and tools: • Terrestrial transmission • Satellite transmission • Cable transmission Explain the features of digital transmission standards Explain digital signals modulation Explain types of digital signal modulation Explain the basics of digital radio Explain the principle of operation of a telephone circuit with the aid of diagram. Explain the concept of		Demonstrate the frequency demodulation with FM modulated signals. Determine how radio receivers operate Visit a television station	Determine how radio receivers operate Visit a television station	

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	of a telephone circuit with the aid of diagram. 1.12 Explain the concept of cellular communication	cellular communication				
General Objective 2.0: Know various frequency bands within the radio frequency spectrum.						
5 – 6	2.1 Define radio frequency 2.2 Explain radio frequency spectrum. 2.3 Explain the frequency ranges allocated to different bands: • Extremely Low Frequency (ELF) • Very Low Frequency (VLF). • Low Frequency (LF) • Medium Frequency (MF) • High Frequency (HF)	Explain radio frequency Explain radio frequency spectrum. Explain the frequency ranges allocated to different bands: • Extremely Low Frequency (ELF) • Very Low Frequency (VLF). • Low Frequency (LF) • Medium Frequency (MF) • High Frequency (HF)	Textbooks Journals Whiteboard, Marker Charts Animations Computer Projector			

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	• Very High Frequency (VHF) • Ultra High Frequency (UHF) • Super High Frequency (SHF) • Extremely High Frequency (EHF) 2.4 Explain the functions of the bands in 2.3 above.	• Very High Frequency (VHF) • Ultra High Frequency (UHF) • Super High Frequency (SHF) • Extremely High Frequency (EHF) Explain the functions of the bands in 2.3 above				
General Objective 3.0: Understand the principles of electro-magnetic wave propagation.						
7 – 10	3.1 Define a wave propagation 3.2 Explain the function of an aerial antenna as a radiator. 3.3 Define a dipole 3.4 Explain the current and voltage distribution of a dipole.	Explain a wave propagation Explain the function of an aerial antenna as a radiator. Explain a dipole Explain the current and voltage distribution of a dipole.	Textbooks Journals Whiteboard Marker Charts Animations Computer Projector	Use appropriate software to simulate the wave propagation of antenna	Guide students to: Use appropriate software to calculate and simulate the wave propagation of antenna	Appropriate software Aerial antenna Wave guides Charts Coaxial cables.

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	3.5 Explain aerial impedance and radiation resistance. 3.6 Define the following terms: • Isotropic radiator • Gain of an aerial • Beam width of an aerial. 3.7 Explain the polar diagram or the radiation pattern of an aerial. 3.8 Explain the horizontal and vertical plane patterns of a horizontal and vertical dipoles. 3.9 Explain various types of aerial antennas 3.10 Explain the effect of frequency on aerial dimensions and performance.	Explain aerial impedance and radiation resistance. Explain the following terms: • Isotropic radiator • Gain of an aerial • Beam width of an aerial. Explain the polar diagram or the radiation pattern of an aerial. Explain the horizontal and vertical plane patterns of a horizontal and vertical dipoles. Explain various types of aerial antennas Explain the effect of frequency on aerial dimensions and performance.				

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	3.11 Explain the factors guiding the choice of aerial antenna.	Explain the factors guiding the choice of aerial antenna.				
General Objectives 4.0: Understand the principle of radio frequency (RF) wave propagation						
11 -12	4.1 Explain the following terms in relation to wave propagation: • Ground waves • Sky waves • Space waves 4.2 Explain troposphere and ionosphere. 4.3 Explain the existence and usefulness of the troposphere. 4.4 Explain the effects of the troposphere on propagation below 30MHZ. 4.5 Explain the various layers of the ionosphere.	Explain the following terms in relation to wave propagation: • Ground waves • Sky waves • Space waves Explain troposphere and ionosphere. Explain the existence and usefulness of the troposphere. Explain the effects of the troposphere on propagation below 30MHZ. Explain the various layers of the ionosphere.	Textbooks Journals Whiteboard Marker Charts Animations Computer Projector			

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	4.6 Explain critical and maximum usable frequency. 4.7 Explain optimum working frequency.	Explain critical and maximum usable frequency. Explain optimum working frequency.				
General Objective 5.0: Understand computer networks						
13-15	5.1 Explain computer networks 5.2 Explain types of computer networks: • Wireless fidelity (WI-FI) • Bluetooth • Intranet 5.3 Explain network topologies: • Mesh • Ring • Bus 5.4 Explain network devices: • NIC	Explain computer networks Explain types of computer networks: • Wireless fidelity (WI-FI) • Bluetooth • Intranet Explain network topologies: • Mesh • Ring • Bus Explain network devices: • NIC	Textbooks Journals Whiteboard Marker Charts Animations Computer Projector	Set up a simple cable network Configure a router Connect two routers or access points Transfer information using: • Wireless fidelity (WI-FI) • Bluetooth • Intranet	Guide students to: Set up a simple cable network Configure a router Connect two routers or access points Transfer information using: • Wireless fidelity (WI-FI) • Bluetooth • Intranet	Router Access points Switch Ethernet cable

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	• Switch • HUB • Repeater • Gateway • Router • Access points 5.5 Explain network protocols: • UDP • TCP/IP 5.6 Explain OSI model	• Switch • HUB • Repeater • Gateway • Router Explain network protocols: • UDP • TCP/IP Explain OSI model				
EVALUATION: The practical class will be awarded 60% of the total score. The continuous assessments, tests and quizzes will be 10% the total score, while the remaining 30% will be for the end of Semester examination.						

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Computer Hardware and Software I

PROGRAMME: NATIONAL DIPLOMA IN ELECTRICAL AND ELECTRONICS ENGINEERING TECHNOLOGY		
COURSE TITLE: Computer Hardware and Software I	**COURSE CODE**: EEC 217	**CONTACT HOURS:** 3
	CREDIT UNIT: 2	**THEORETICAL**: 1
YEAR: II **SEMESTER:** I	**PRE-REQUISITE:** NIL	**PRACTICAL:** 2
GOAL: This course is designed to equip students with basic knowledge and skills on computer hardware and specialized software packages.		
GENERAL OBJECTIVES: On completion of this course, the students should be able to: 1.0 Understand the basic functions of a computer 2.0 Understand the computer hardware components 3.0 Understand Human-Computer Interaction 4.0 Understand the Language of software packages. 5.0 Understand the operation of computer hardware components		

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PROGRAMME: NATIONAL DIPLOMA IN ELECTRICAL AND ELECTRONICS ENGINEERING TECHNOLOGY					
COURSE TITLE: Computer Hardware and Software I		**COURSE CODE**: EEC 217		**CONTACT HOURS:** 3	
		CREDIT UNIT: 2		**THEORETICAL**: 1	
YEAR: II **SEMESTER:** I		**PRE-REQUISITE:** NIL		**PRACTICAL:** 2	
COURSE SPECIFICATION: THEORETICAL AND PRACTICAL					
GOAL: This course is designed to equip students with basic knowledge and skills on computer hardware and specialized software packages.					
General Objective 1.0: Understand the basic functions of a computer.					
THEORETICAL CONTENT				PRACTICAL CONTENT	
Week	**Specific Learning Outcome**	**Teacher's Activities**	**Resources**	**Specific Learning Outcome**	**Teacher's Activities**	**Resources**
1-3	1.1 Define computer. 1.2 Explain the evolution of computer. 1.3 Explain the application of computers. 1.4 Explain the impact of technology on Personal Computer (PC). 1.5 Differentiate between hardware and software.	Explain computer Explain the evolution of computer. Explain the application of computers Explain the impact of technology on Personal Computer (PC) Explain the differences between hardware and software.	Whiteboard Marker Textbooks Computer Internet Projector	Identify computer components Dismantle a computer system and show the: • RAM card • Hard Disk • Processors. Identify: • Input mechanisms Output Mechanisms	Guide the students to: Identify computer components Dismantle a computer system and show the: • RAM card • Hard Disk • Processors. Identify: • Input mechanisms Output Mechanisms	Computer

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	1.6 Explain the input-process-output algorithm (hardware): • Central processor • Input mechanisms • Output Mechanisms 1.7 Explain microprocessors, inputs and outputs devices 1.8 Explain the need for data storage 1.9 Explain how data is stored in: • RAM • ROM • Fixed discs Removable discs	Explain the input-process-output algorithm (hardware). • Central processor • Input mechanisms • Output Mechanisms Explain microprocessors, inputs and outputs devices Explain the need for data storage. Explain how data is stored in: • RAM • ROM • Fixed discs Removable discs				
General Objective 2.0: Understand the computer hardware components						
4-6	2.1 Define computer. 2.2 Explain types of computers	Explain computer. Explain types of computers	Whiteboard Marker Textbooks Computer	Assemble computer sub-units.	Guide the students to: Assemble computer sub-units	Computer auxiliary unit Computer

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	2.3 Enumerate components of computer hardware: • Input/output • System Unit • Processing unit • Storage devices 2.4 List major subunits of a computer: • Mother board (ATX, Micro-ATX, and Mini-ITX Form Factors), • Drives (Hard disk, Floppy, CD-ROM, Zip), • Ports. 2.5 Explain SSD and HDD technologies 2.6 Explain the technical aspects of cables connecting the units. 2.7 Explain how data is transferred down the	Explain the components of a computer hardware: • Input/output • System Unit • Processing unit • Storage devices Explain major subunits of a computer: • Mother board (ATX, Micro-ATX, and Mini-ITX Form Factors), • Drives (Hard disk, Floppy, CD-ROM, Zip), • Ports. Compare SSD and HDD technologies Explain the technical aspects of cables connecting the units. Explain how data is	Internet Projector	Identify the memory, ports, CPU and power supply unit Identify the computer CMOS battery for memory retention. Identify the various types of port: • Parallel • Serial • USB Identify the components of a computer hardware: • Input/output System Unit • Processing unit • Storage devices	Identify the memory, ports, CPU and power supply unit Identify the computer CMOS battery for memory retention. Identify the various types of ports: Parallel • Serial • USB Identify the components of a computer hardware: • Input/output System Unit • Processing unit • Storage devices	peripheral units Central processing units (CPU) I/O devices, tools and measuring instruments. Scraps of computer system.

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	cables and the type of hand- shake methods used.	transferred down the cables and the type of hand- shake methods used.				
General Objective 3.0: Understand Human-Computer Interaction.						
7-8	3.1 Explain the concept of operating system • PC-DOS/MS-DOS • Windows • Linux Unix 3.2 Explain the advantage of the Windows Operating System. 3.3 Explain the windows menu and tools 3.4 Explore modern operating systems like: • Windows 11 • Linux distributions • MacOS. 3.5 Explain the advantage of: • Windows Operating	Explain the concept of operating system • PC-DOS/MS-DOS • Windows • Linux Unix Explain the advantage of the Windows operating System. Explain the windows menu and tools Explore modern operating systems like: • Windows 11 • Linux distributions • MacOS. Explain the advantage of: • Windows	Whiteboard Marker Textbooks Computer Internet Projector	Access computers correctly through Windows operating system such as: • Open/Close a window • Program Manager • Button bars/scroll bars/ menu bars • Moving from one Window to another	Guide students to: Access computers correctly through Windows operating system such as: • Open/Close a window • Program Manager • Button bars/scroll bars/ menu bars • Moving from one Window to another	Computers Operating system Application packages

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	System • Windows menu and tools 3.6 Explain mobile operating systems (Android, iOS) and their user interface	Operating System • Windows menu and tools Explain mobile operating systems (Android, iOS) and their user interface				
General Objective 4.0: Understand Application software packages.						
9-10	4.1 Explain file management 4.2 Explain how to manage files. 4.3 Explain the concepts of software packages such as: • MSOffice • Lotus SmartSuite • MS Encarta 4.4 Explain the steps involved in installation of MS-Words. 4.5 Explain the steps involved to competently	Explain file management Explain how to manage files. Explain the concepts of software packages such as: • MSOffice • Lotus SmartSuite • MS Encarta Explain the steps involved in installation of MS-Words. Explain the steps involved to competently operate	Whiteboard Marker Textbooks Computer Internet Projector	Create a file and folder Manipulate files (moving, copying, saving, deleting). Manipulate Print Manager. Demonstrate the competent use of a word-processing package such as: • MSWord (or equivalent standard). • Entering text • Formatting text (emboldening, font size, italicizing).	Guide students to: Create a file and folder Manipulate files (moving, copying, saving, deleting). Manipulate Print Manager Demonstrate the competent use of a word-processing package such as: • MSWord (or equivalent standard). • Entering text • Formatting text (emboldening,	Computers Printers Papers Computers Application packages

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	operate MS word or equivalents standard. 4.6 Describe the different features of the software 4.7 Explain cloud-based applications and collaborative tools: e.g.: • Google Workspace • Microsoft 365 4.8 Explain cyber security implications of using software packages.	MS word or equivalents standard. Explain the different features of the software Explain cloud-based applications and collaborative tools: e.g.: • Google Workspace • Microsoft 365 Explain cyber security implications of using software packages.		• Creating and Saving text files • Editing and moving text • Importing objects • Spelling and Grammar Checking. • Create tables, text boxes, equations. • Type a short document and save it. • Edit a document and carryout a spelling check. • Demonstrate the use of tables. • Use the Internet to retrieve information. • World Wide Web(WWW) • Download information • Paste retrieved information into an appropriate	font size, italicizing). • Creating and Saving text files • Editing and moving text • Importing objects • Spelling and Grammar Checking. • Create tables, text boxes, equations. • Type a short document and save it. • Edit a document and carryout a spelling check. • Demonstrate the use of tables. • Use the Internet to retrieve information. • World Wide Web(WWW) • Download information • Paste retrieved	

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				application • Use-mail to send and receive messages. • National and international e-mail E-mail attachments (sending& receiving)	information into an appropriate application • Use-mail to send and receive messages. • National and international e-mail E-mail attachments (sending& receiving)	
General Objective 5.0: Understand the operation of computer hardware components						
11-14	5.1 Explain the operations of computer 5.2 Explain: • Memory • Ports • CPU • Power supply • Battery supply for memory retention. 5.3 Explain the protocols of	Explain the operations of computer Explain: • Memory • Ports • CPU • Power supply • Battery supply for memory retention	Whiteboard Marker Textbooks Computer Internet Projector	Demonstrate how to start and shut down a computer system. Identify different types of cables and connectors. Demonstrate how to connect Computer Ports to peripherals. Demonstrate how you	Guide students to: Demonstrate how to start and shut down a computer system. Identify different types of cables and connectors. Demonstrate how to connect Computer Ports to peripherals.	PC with Presentation package installed and connected to multimedia projector Computer auxiliary units Computer peripherals, tools and

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	various port: Parallel, Serial; USP. 5.4 Explain the functions of the Ports listed 2.3 above. 5.5 Explain the characteristics of monitors: • Scanning Speed • Colour resolution, etc. 5.6 Explain the functions and operation of monitors 5.7 Explain how to select monitors for different mother board's speed and resolution. 5.8 Explain the operation of aprinter. 5.9 List different types of printers e.g.: • Line	Explain the protocols of various port: Parallel, Serial; USP. Explain the functions of the Ports listed 2.3 above. Explain the characteristics of monitors: • Scanning Speed • Colour resolution, etc. Explain the functions and operation of monitors Explain how to select monitors for different mother board's speed and resolution. Explain the operation of a printer. Explain different types of printers e.g.: • Line		can setup and connect a printer to a computer. Setup some printing exercise Identify a modem and draw a block diagram of a modem Draw a block diagram showing the interconnection of the Sub-units of the motherboard.	Demonstrate how you can setup and connect a printer to a computer. Setup some printing exercise Identify a modem and draw a block diagram of a modem Draw a block diagram showing the interconnection of the Sub-units of the motherboard.	measuring instruments Central processing units I/O devices. Computer toolboxes Electrostatic discharge hand. Scraps of computer system.

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	• Dot • Laser • Deskjet, etc. 6.10 Explain the difference between various types of Printer heads. 6.11 Explain the operation of a modem and its classification such as: • V Series • X Series 6.12 Explain the concepts of networking.	• Dot • Laser • Deskjet, etc. Explain the difference between various types of Printer heads. Explain the operation of a modem and its classification such as: • V Series • X Series Explain the concepts of networking.				
ASSESSMENT: The continuous assessment, tests and quizzes will be awarded 60% of the total score. The end of the Semester Examination will make-up for the remaining 40% of the total score.						

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Research Methods in Electrical and Electronics Engineering Technology

PROGRAMME: NATIONAL DIPLOMA ELECTRICAL AND ELECTRONICS ENGINEERING TECHNOLOGY		
COURSE TITLE: Research Methods in Electrical and Electronics Engineering Technology	**COURSE CODE:** EEC 218	**CONTACT HOURS**: 2
	CREDIT UNIT: 2	**THEORETICAL:** 2
YEAR: II **SEMESTER:** I	**PRE-REQUISITE:**	**PRACTICAL:**0
GOAL: This course is designed to equip the student with the knowledge and skills of Research Methods in Electrical and Electronics Engineering Technology		
GENERAL OBJECTIVES: On completion of this course, the students should be able to: 1.0 Understand the Concept of Research in Electrical and Electronics Engineering Technology 2.0 Understand Terminologies in Electrical and Electronics Engineering Research 3.0 Understand the Methods of Research in Electrical and Electronics Engineering 4.0 Understand Sampling Techniques in Electrical and Electronics Engineering Research 5.0 Understand Data Collection Techniques in Electrical and Electronics Engineering Research 6.0 Understand Research Report Writing and Presentation in Electrical and Electronics Engineering		

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PROGRAMME: NATIONAL DIPLOMA ELECTRICAL AND ELECTRONICS ENGINEERING TECHNOLOGY					
COURSE TITLE: Research Methods in Electrical and Electronics Engineering Technology		**COURSE CODE:** EEC 218		**CONTACT HOURS**: 2	
		CREDIT UNIT: 2		**THEORETICAL:** 2	
YEAR: II **SEMESTER:** I		**PRE-REQUISITE:**		**PRACTICAL:** 0	
COURSE SPECIFICATION: THEORETICAL AND PRACTICAL					
GOAL: This course is designed to equip the student with the knowledge and skills of Research Methods in Electrical and Electronics Engineering Technology					
General Objective 1.0: Understand the Concept of Research in Electrical and Electronics Engineering Technology					
THEORETICAL CONTENT				PRACTICAL CONTENT	
Week	Specific Learning Outcome	Teacher's Activities	Resources	Specific Learning Outcome	Teacher's Activities	Resources
1-3	1.1 Define research 1.2 Explain the importance in EEET: • Advancements in IoT • Power systems. 1.3 Explain types of research: • Quantitative, • Qualitative, • Mixed Methods. 1.4 Explain the purpose of research and its application in EEET:	Explain research Explain the importance in EEET: • Advancements in IoT • Power systems. Explain types of research: • Quantitative, • Qualitative, • Mixed Methods. Explain the purpose of research and its application in EEET:	Textbooks Journals Computer Internet Projector Marker Marker Board			

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	• Efficiency • improvement, • fault detection, etc. 1.5 Explain sources of knowledge in engineering • Standards, • Experimentation. 1.6 Explain the elements of scientific research methods.	• Efficiency • improvement, • fault detection, etc. Explain sources of knowledge in engineering • Standards, • Experimentation. Explain the elements of scientific research methods.				
General Objective 2.0: Understand Terminologies in Electrical and Electronics Engineering Research						
4-6	2.1 Define evidence, fact, and data as they apply to EEET. 2.2 Explain the following: • Concepts • Constructs • Propositions • Variables • Assumptions. 2.3 Explain types of variables	Explain evidence, fact and data Explain the following: • Concepts • Constructs • Propositions • Variables • Assumptions Explain types of variables	Textbooks Journals Computer Internet Projector Marker Marker Board Internet Research project/reports			

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	• Dependent, • Independent • Controlled). 2.4 Explain conceptualization and operationalization in EEET research.	• Dependent, • Independent • Controlled). Explain conceptualization and operationalization in EEET research.				
General Objective 3.0: Understand the Methods of Research in Electrical and Electronics Engineering						
7-8	3.1 Define research methods 3.2 Explain the importance of research methods in EEET. 3.3 Explain types of research methods: • Experimental, • Simulation-based • Analytical. 3.3 Explain methodologies under each type in 3.3 • Circuit testing • Simulation of power	Explain research method Explain the importance of research methods in EEET. Explain types of research methods: • Experimental, • Simulation-based • Analytical. Explain methodologies under each type in 3.3 • Circuit testing	Textbooks Journals Computer Internet Projector Marker Marker Board Research reports Internet			

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	systems	• Simulation of power systems				
General Objective 4.0: Understand Sampling Techniques in Electrical and Electronics Engineering Research						
9-11	4.1 Define sampling 4.2 Explain census in the context of EEET. 4.3 Explain methods of sampling: • Probability • Non-probability. 4.4 Explain sampling techniques under each method in 4.3 4.5 Explain factors influencing the choice of sampling technique	Explain sample Explain Census in the context of EEET. Explain methods of sampling: • Probability • Non- probability Explain sampling techniques under each method in 4.3 Explain factors influencing the choice of sampling technique	Textbooks Journals Computer Internet Projector Marker Marker Board	Identify sampling techniques Use the selected technique to a draw sample	Guide students: Identify sampling techniques Use the selected technique to a draw sample	Sample project/sample report Street Directories
General Objective 5.0: Understand Data Collection Techniques in Electrical and Electronics Engineering Research						
12-13	5.1 Define data 5.2 Explain types of data: • Quantitative, • Qualitative 5.3 Explain sources of data: • Experimental	Explain Data Explain types of Data • Quantitative, • Qualitative Explain sources of data:	Textbooks Journals Computer Internet Projector Marker Marker Board	Identify types of data Identify sources of data Use data collection	Guide students: Identify types of data Identify sources of data Use data collection	Sample data

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	results, • Manufacturer datasheets. 5.4 Explain data collection techniques: • Use of multimeters, • Oscilloscope readings 5.5 Define data analysis 5.6 Explain methods of data analysis: • Fourier analysis, • Statistical evaluations 5.7 Explain tools for data presentation: • Tables • Charts • Graphs.	• Experimental results, • Manufacturer datasheets. Explain data collection techniques • Use of multimeters, • Oscilloscope readings Explain data analysis Explain methods of data analysis • Fourier analysis, • Statistical evaluations Explain tools for data presentation: • Tables • Charts • Graphs		techniques to conduct research Use statistical tools to present data	techniques to conduct research Use statistical tools to present data	
General Objective 6.0: Understand Research Report Writing and Presentation in Electrical and Electronics Engineering						
14-15	6.1 Define report writing and presentation 6.2 Explain the stages of	Explain research report writing and presentation Explain stages of	Textbooks Journals Computer Internet Projector	Write research report	Guide students to write research report.	Sample reports

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	writing a research report: • Introduction • Methodology • Results. 6.3 Explain the process of research idea generation 6.4 Explain proposal writing: • Objectives • Problem statements 6.5 Explain the use of technologies in research: • MATLAB • Simulation tools 6.6 Explain ethical issues in EEET research: • Intellectual property).	research reports writing: • Introduction • Methodology • Results. Explain how to generate research ideas Explain how to write research reports Explain the use of new technologies in EEET research. Explain ethical issues in EEET research	Marker Marker-Board			

EVALUATION: CA 40% EXAMINATION: 60%

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YEAR TWO, SEMESTER TWO

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Trigonometry and Analytical Geometry

PROGRAMME: NATIONAL DIPLOMA IN ELECTRICAL AND ELECTRONICS ENGINEERING TECHNOLOGY		
COURSE Trigonometry and Analytical Geometry	**COURSE CODE:** MTH 221	**CONTACT HOURS:** 2
	CREDIT UNIT: 2	**THEORETICAL:** 2
YEAR: II **SEMESTER:** II	**PRE-REQUISITE:**	**PRACTICAL:** 0
GOAL: This course is designed to acquaint students with the basic knowledge of Trigonometry and Analytical Geometry		
GENERAL OBJECTIVES: On completion of this course, the student should be able to: 1.0 Understand the manipulation of trigonometric equations. 2.0 Understand the concept of mensuration and its application to engineering problems 3.0 Understand the concept of analytical geometry and their applications 4.0 Understand the concept of Parabola, ellipse and hyperbola.		

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PROGRAMME: NATIONAL DIPLOMA IN ELECTRICAL AND ELECTRONICS ENGINEERING TECHNOLOGY						
COURSE Trigonometry and Analytical Geometry			**COURSE CODE:** MTH 221	**CONTACT HOURS:** 2		
			CREDIT UNIT: 2	**THEORETICAL:** 2		
YEAR: II **SEMESTER:** II			**PRE-REQUISITE:**	**PRACTICAL:** 0		
COURSE SPECIFICATION: THEORETICAL AND PRACTICAL						
GOAL: This course is designed to acquaint students with the basic knowledge of Trigonometry and Analytical Geometry						
General Objective 1.0: Understand the manipulation of trigonometric equations.						
THEORETICAL CONTENT				**PRACTICAL CONTENT**		
Week	**Specific Learning Outcome**	**Teachers Activities**	**Resources**	**Specific Learning Outcome**	**Teachers Activities**	**Resources**
1-3	1.1 Convert sums and differences of trigonometric ratios to products. 1.2 Prove the sine and cosine formulae of triangles 1.3 Solve problems triangles using the sine and cosine formulae e.g.:-The sides a,b,c, of a triangle are 4cm, 5cm, and 6cm respectively. Find the angles.	Convert sums and differences of trigonometric ratios to products. Prove the sine and cosine formulae of triangles Solve problems triangles using the sine and cosine formulae e.g.:-The sides a,b,c, of a triangle are 4cm, 5cm, and 6cm respectively. Find the angles.	Textbooks Lecture notes Whiteboard Marker			

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	1.4 Calculate angles of elevation and depression using trigonometric ratios e.g.:- From the top of a tree 120m high an observer sees a boat 560m away. Calculate the angle of depression.	Calculate angles of elevation and depression using trigonometric ratios e.g.:- From the top of a tree 120m high an observer sees a boat 560m away. Calculate the angle of depression.				
	1.5 Compute bearings, heights and distances of inaccessible objects and projections, e.g. - A man walks 3km due North, and the 3km N.52° W. How far is the man from his starting point? What is his bearing from his original position.	Compute bearings, heights and distances of inaccessible objects and projections,e.g. - A man walks 3km due North, and the 3km N.52° W. How far is the man from his starting point? What is his bearing from his original position.				
	1.6 Derive half angle formulae from sin, cos and tan.	Derive half angle formulae from sin, cos and tan.				
	1.7 Define inverse circular function.	Define inverse circular function.				

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	1.8 Explain inverse circular functions graphically. 1.9 Solve problems involving 1.8 and e.g.:- Draw the graph of 1/(cos 2θ) Taking values from0° to 90° inclusive. 1.10 Apply the concepts in 1.8 above to three dimensional problems.	Explain inverse circular functions graphically. Solve problems involving 1.8 and e.g.:- Draw the graph of 1/(cos 2θ) Taking values from0° to 90° inclusive. Apply the concepts in 1.8 above to three dimensional problems.				
General Objective 2.0: Understand the concept of mensuration and its application to engineering problems						
4 - 5	2.1 Explain circular measure. 2.2 State the relation between radians and degrees 2.3 Prove the formulae for arc length and area of a sector. 2.4 Identify segment and chord of a circle. 2.5 Determine the area of a segment and the chord of	Explain circular measure. Explain the relation between radians and degrees Prove the formulae for arc length and area of a sector. Explain segment and chord of a circle. Determine the area of a	Lecture notes Textbooks Charts Whiteboard Marker			State the relation between radians and degrees

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	length of a given circle. 2.6 Calculate the surface areas and volumes of simples shapes such as cylinder, sphere and cone. E.g. A solid sphere has radius 8cm. Calculate its volume. 2.7 Determine the areas and volumes of irregular shapes applying Simpsons rule. 2.8 Apply mid-ordinate rule to determine the areas and volumes applying mid-ordinate rule.	segment and the chord of length of a given circle. Calculate the surface areas and volumes of simples shapes such as cylinder, sphere and cone. E.g. A solid sphere has radius 8cm. Calculate its volume. Determine the areas and volumes of irregular shapes applying Simpsons rule. Apply mid-ordinate rule to determine the areas and volumes applying mid-ordinate rule.				
General Objective 3.0: Understand the concept of analytical geometry and their applications						

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6-9	3.1 Explain two dimensional coordinate systems: Cartesian and Polar coordinate systems. 3.2 Explain plotting and sketching of graphs w.r.t. the two coordinate systems. 3.3 Relate Cartesian coordinate to polar coordinates. 3.4 Explain the slope of a line in relation to the above concepts in 3.3. above. 3.5 Explain the intercept of a line. 3.6 Derive the formula for the gradient of line passing through two points. 3.7 Derive the equation of a straight line given the gradient and the co-	Explain two dimensional coordinate systems: Cartesian and Polar coordinate systems. Explain plotting and sketching of graphs w.r.t. the two coordinate systems. Relate Cartesian coordinate to polar coordinates. Explain the slope of a line in relation to the above concepts in 3.3. above. Explain the intercept of a line. Derive the formula for the gradient of line passing through two points. Derive the equation of	Lecture notes Textbooks Charts Whiteboard Marker			Relate Cartesian coordinate to polar coordinates

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	ordinates of a point. 3.8 Reduce a given linear equation to the intercept form. x/a + y/b = 1 3.9 Determine the coordinates of the point of intersection of two straight lines. 3.10 Define locus 3.11 Derive the slope-intercept form of the equation of a straight line: y = mx+c 3.12 Derive the point - slope form of the equation of a straight line: $y - y_1 = m(x - x_1)$. 3.13 Derive the double – point form of the equations of the straight line: $y - y_1 = \frac{y_2 - y_1}{(x - x1)\ x_2 - x_1}$	straight line given the gradient and the co-ordinates of a point Reduce a given linear equation to the intercept form. x/a + y/b = 1 Determine the coordinates of the point of intersection of two straight lines. Define locus Derive the slope-intercept form of the equation of a straight line: y = mx+c Derive the point – slope form of the equation of a straight line: $y - y_1 = m(x - x_1)$. Derive the double – point form of the equations of the straight				

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	3.14 Derive the perpendicular form of the equation of a straight line 3.15 Solve examples of 3.11 to 3.14 above. 3.16 Find the angle (Q) between two lines whose slopes, (m_1, and m_2) are Known: $Q= \tan (m_2 - m_1)/1 + m_1 m_2$ 3.17 Determine the conditions for two lines to be parallel and to be perpendicular. 3.18 Derive the expression for the perpendicular distance from a point to a line. 3.19 Draw a circle. 3.20 Derive the equation of a circle with center at the origin and radius r.	line: $y - y_1 = \frac{y_2 - y_1}{x_2 - x_1}(x - x1)$ Derive the perpendicular form of the equation of a straight line Solve examples of 3.11 to 3.14 above. Find the angle (Q) between two lines whose slopes, (m_1, and m_2) are Known: $Q= \tan (m_2 - m_1)/1 + m_1 m_2$ Determine the conditions for two lines to be parallel and to be perpendicular. Derive the expression for the perpendicular distance from a point to a line. Draw a circle.				

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	3.21 Derive the equation of a circle with center outside the origin. 3.22 State general equation of a circle. 3.23 Determine the coordinates of the center of a circle from a given equation of a circle. 3.24 Draw orthogonal circles 3.25 Find the equations of the tangent and the normal at a point circle 3.26 List illustrative examples of each of 3.20 to 3.25 above	Derive the equation of a circle with center at the origin and radius r. Derive the equation of a circle with center outside the origin. State general equation of a circle. Determine the coordinates of the center of a circle from a given equation of a circle. Draw orthogonal circles Find the equations of the tangent and the normal at a point circle List illustrative examples of each of 3.20 to 3.25 above				
General Objective 4.0: Understand the concept of Parabola, ellipse and hyperbola.						
10-12	4.1 Define the Parabola	Define the Parabola				Derive the standard

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	4.2 Derive the standard equation of a Parabola $y^2 = 4ax$ 4.3 State the properties of the Parabola 4.4 Define the focal chord, axis and locus rectum of the parabola 4.5 Determine the equation of the tangent and normal from a given point to the parabola. 4.6 Solve problems on parabola e.g. Write down the equation of the parabola and state its vertex if the focus - is (2,0)and the directrix x = - 2. 4.7 Define an ellipse. 4.8 Derive the equation of an ellipse $x^2/G^2 + y^2/b^2 = 1$	Derive the standard equation of a Parabola $y^2 = 4ax$ State the properties of the Parabola Explain the focal chord, axis and locus rectum of the parabola Determine the equation of the tangent and normal from a given point to the parabola. Solve problems on parabola e.g. Write down the equation of the parabola and state its vertex if the focus - is (2,0)and the directrix x = - 2. Define an ellipse. Derive the equation of an ellipse $x^2/G^2 + y^2/b^2 = 1$				equation of a Parabola $y^2 = 4ax$

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	4.9 State the properties of the Ellipse. 4.10 Determine the equation of the tangent and the normal to an ellipse from a given point. 4.11 Define focal chord and axis of ellipse. 4.12 Solve problems on ellipses e.g. Find the length of the axis and the eccentricity for the ellipse: $4x^2 + 9y^2 = 36$ 4.13 Define the Hyperbola. 4.14 Derive the equation of the Hyperbola. 4.15 Identify the properties of the Hyperbola. 4.16 Define asymptoes, chord, tangent and normal to a hyperbola.	State the properties of the Ellipse. Determine the equation of the tangent and the normal to an ellipse from a given point. Define focal chord and axis of ellipse. Solve problems on ellipses e.g. Find the length of the axis and the eccentricity for the ellipse: $4x^2 + 9y^2 = 36$ Define the Hyperbola. Derive the equation of the Hyperbola. Identify the properties of the Hyperbola. Define asymptoes, chord, tangent and normal				

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	4.17 Solve problems on hyperbola e.g. Find the foci and directrixes for hyperbola: $x^2/16 - y^2/9 = 1$ 4.18 Explain rectangular hyperbola. 4.19 Determine tangent and normal to the rectangular Hyperbola.	to a hyperbola. Solve problems on hyperbola e.g. Find the foci and directrixes for hyperbola: $x^2/16 - y^2/9 = 1$ Explain rectangular hyperbola. Determine tangent and normal to the rectangular Hyperbola.				

EVALUATION; EXAMINATION: 60% C.A: 40%

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Electrical Power III

PROGRAMME: NATIONAL DIPLOMA IN ELECTRICAL AND ELECTRONICS ENGINEERING TECHNOLOGY		
COURSE TITLE: Electrical Power III	**COURSE CODE:** EEC 221	**CONTACT HOURS:** 3
	CREDIT UNIT: 2	**THEORY:** 1
YEAR: II **SEMESTER:** II	**PRE-REQUISITE:** EEC 211	**PRACTICAL**: 2
GOAL: This course is designed to acquaint the students with the knowledge and skills of the principles of power systems		
GENERAL OBJECTIVES: On completion of this course, the student should be able to: 1.0 Understand the performance of load flow in an interconnected power system. 2.0 Understand the fault analysis in interconnected power systems. 3.0 Understand the principles of protection systems.		

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PROGRAMME: NATIONAL DIPLOMA IN ELECTRICAL AND ELECTRONICS ENGINEERING TECHNOLOGY						
COURSE TITLE: Electrical Power III		**COURSE CODE:** EEC 221		**CONTACT HOURS:** 3		
		CREDIT UNIT: 2		**THEORETICAL:** 1		
YEAR: II **SEMESTER:** II		**PRE-REQUISITE:** EEC 211		**PRACTICAL:** 2		
COURSE SPECIFICATION: THEORETICAL AND PRACTICAL						
GOAL: This course is designed to acquaint the students with the knowledge and skills of the principles of power systems						
General Objective 1.0: Understand the performance of load flow in an interconnected power system.						
THEORETICAL CONTENT:				**PRACTICAL CONTENT:**		
Week	**Specific Learning Outcome**	**Teachers' Activities**	**Resources**	**Specific Learning Outcome**	**Teachers' Activities**	**Resources**
1-5	1.1 Explain interconnected power systems. 1.2 State the advantages and disadvantages of interconnected power Systems. 1.3 Explain the power circle diagram. 1.4 Describe the techniques for reducing interconnected power systems to simple equivalent diagrams.	Explain interconnected power systems. Explain the advantages and disadvantages of interconnected power Systems. Explain the power circle diagram. Explain the techniques for reducing interconnected power systems to simple equivalent diagrams.	Textbook Journals Whiteboard Marker Charts Animations Computer Projector	Determine the sending and receiving end voltage of the transmission line. Determine the voltage regulation and transmission efficiency. Conduct a load flow study of two bus	Guide students to: Determine the sending and receiving end voltage of the transmission line. Determine the voltage regulation and transmission efficiency. Conduct a load flow study of two bus power network using appropriate	Transmission line trainer Ammeter Voltmeter Wattmeter Computers with appropriate software.

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	1.5 Explain the need for a power flow study. 1.6 State the benefits of power flow study. 1.7 Explain the nodal admittance matrices for a two-bus network. 1.8 State the variables affecting the load flow in power system network. 1.9 State which variables are control dependent and independent. 1.10 State the general form of the load flow equation in: • Rectangular form • Polar form 1.11 Explain the Gauss-Seidel method of load flow solution	Explain the need for a power flow study. Explain the benefits of power flow study. Explain the nodal admittance matrices for a two-bus network. Explain the variables affecting the load flow in power system network. Explain which variables are control dependent and independent. Explain the general form of the load flow equation in: • Rectangular form • Polar form Explain the Gauss-Seidel method of load flow solution.		power network using appropriate software Run a programme for a load flow analysis of a two-bus power network. Construct the power circle diagram. Formulate the nodal admittance matrices for a two-bus network. Calculate the load flow in an interconnected system Classify the variables in 1.9 into control dependent	software Run a programme for a load flow analysis of a two-bus power network. Construct the power circle diagram. Formulate the nodal admittance matrices for a two-bus network. Calculate the load flow in an interconnected system Classify the variables in 1.9 into control dependent and	

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	1.12 Solve problems on load flow analysis for interconnected systems. 1.13 Explain the application of computers to conduct load flow study. 1.14 Explain a computer programme for a load flow analysis of a two-bus power network. 1.15 Explain Circuit parameters: P, Q, S, V and $\wp$ variables affecting the load flow in the power system network.	Explain how to solve problems on load flow analysis for interconnected systems. Explain the application of computers to conduct load flow study. Explain a computer programme for a load flow analysis of a two-bus power network Explain Circuit parameters: P, Q, S, V and $\wp$ variables affecting the load flow in the power system network.		and independent	independent	
General Objective 2.0: Understand the fault analysis in interconnected power systems.						
6-9	2.1 State types of faults that can occur on generators, transformers and transmission lines. 2.2 Explain short-circuit, open circuit and earth faults on transmission lines.	Explain types of faults that can occur on generators, transformers and transmission lines. Explain short-circuit, open circuit and earth faults on transmission lines.	Textbook Journal Whiteboard Marker Charts Animations Computer Projector	Identify the faults on generators, transformers and T-line. Insert an open	Guide students to: Identify the faults on generators, transformers and T-line. Insert an open circuit and earth	Wattmeter Voltmeter Ammeter Phase sequence

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	2.3 State the transient and sub-transient reactances. 2.4 Explain the sub-transient and transient reactances using the appropriate waveform of a faulted generator. 2.5Explain typical waveforms of short circuit currents in power systems. 2.6 State a symmetrical fault. 2.7 Solve symmetrical fault problems using the one-line diagram and the per-unit system method. 2.8 Derive expressions for the symmetrical components for positive, negative and zero sequences in terms of the transmission line parameters.	Explain the transient and sub-transient reactances. Explain the sub-transient and transient reactances using the appropriate waveform of a faulted generator. Explain typical waveforms of short circuit currents in power systems. Explain a symmetrical fault. Explain how to solve symmetrical fault problems using the one-line diagram and the per-unit system method. Derive expressions for the symmetrical components for positive, negative and zero sequences in terms of the transmission line parameters.	.	circuit and earth faults on transmission lines using appropriate software Determine the fault levels on typical power systems. Determine the MVA fault level on typical power systems. Draw typical waveforms of short circuit currents in power systems.	faults on transmission lines using appropriate software Determine the fault levels on typical power systems. Determine the MVA fault level on typical power systems. Draw typical waveforms of short circuit currents in power systems.	meter Oscilloscope Computers with appropriate software

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	2.9 State the expression for power in the symmetrical component. 2.10 Define unsymmetrical (asymmetrical) faults for • a. Single-line to ground • Double-line to ground • Line-to-Line 2.11 Solve unsymmetrical fault problems using the symmetrical component of networks. 2.12 Explain the sequence impedance of a power system using symmetrical components. 2.13 Explain the sequence network for a given power system. 2.14 Calculate the MVA fault level on typical power systems.	Explain the expression for power in the symmetrical component. Explain unsymmetrical (asymmetrical) faults for • Single-line to ground • Double-line to ground • Line-to-Line. Explain how to solve unsymmetrical fault problems using the symmetrical component of networks. Explain the sequence impedance of a power system using symmetrical components. Explain the sequence network for a given power system. Calculate the MVA fault level on typical power systems.				

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	2.15 Describe methods of selecting circuit breakers, switch gears bus bars, fuses for typical fault levels.	Explain methods of selecting circuit breakers, switch gears bus bars, fuses for typical fault levels				
General Objective 3.0: Understand the principles of protection systems						
10-15	3.1 Explain the corona effect 3.2 Explain the factors affecting corona effect 3.3 Explain the causes of overvoltage in power systems. 3.4 Explain surge waveform. 3.5 State the possible effects of a travelling wave on the transmission line. 3.6 Solve problems involving surge voltage in the following: • Single phase line • Three phase line • Single-phase	Explain the corona effect Explain the factors affecting corona effect Explain the causes of overvoltage in power systems. Explain surge waveform. Explain the possible effects of a travelling wave on the transmission line. Explain how to solve problems involving surge voltage in the following: • Single phase line • Three phase line • Single-phase	Textbook Journal Whiteboard Marker Charts Animations Computer Projector	Plot graphs for voltage and current surges when R is less than Z_o (R< Z_o) Test Insulators to determine their voltage distribution and string efficiency. Draw a typical surge waveform. Identify lightning arrester	Guide students to: Plot graphs for voltage and current surges when R is less than Z_o (R< Z_o) Test Insulators to determine their voltage distribution and string efficiency. Draw a typical surge waveform. Identify lightning arrester	Transmission line demonstrator Ammeter Voltmeter Wattmeter Insulators Insulation tester Relay Data Plotting materials.

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	concentric cable. 3.7 Explain an expression for reflected surge voltage and current. 3.8 Define: • Reflecting factor coefficient (p) • Transmission factor coefficient (t) 3.9 Explain the protection scheme of transmission lines against possible lightning surges. 3.10 Explain the effect of a surge on an overhead line terminating to a transformer. 3.11 Explain methods of testing insulators. 3.12Describe insulation co-ordination in overhead lines.	concentric cable. Explain an expression for reflected surge voltage and current. Explain: • Reflecting factor coefficient (p) • Transmission factor coefficient (t) Explain the protection scheme of transmission lines against possible lightning surges. Explain the effect of a surge on an overhead line terminating to a transformer. Explain methods of testing insulators. Explain insulation co-ordination in overhead lines.		Classify relays	Classify relays	

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	3.13 Explain the principles of operation of an impulse generator 3.14 Explain relays 3.15 Explain the operation principles of relays 3.16 Explain the classification of relay	Explain the principles of operation of an impulse generator Explain relays Explain the operation principles of relays Explain the classification of relay				
ASSESSMENT: The practical class will be awarded 60% of the total score. The continuous assessments, tests and quizzes will take 10% of the total score, while the remaining 30% will be for the end-of-the-semester examination score.						

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Computer Hardware and Software II

PROGRAMME: NATIONAL DIPLOMA IN ELECTRICAL AND ELECTRONICS ENGINEERING TECHNOLOGY		
COURSE TITLE: Computer Hardware and Software II	**COURSE CODE**: EEC 222	**CONTACT HOURS**: 3
	CREDIT UNIT: 2	**THEORETICAL:** 1
YEAR: II **SEMESTER:** II	**PRE-REQUISITE:**	**PRACTICAL:** 2
GOAL: This course is designed to equip students with knowledge and skills on how to diagnose and rectify simple faults on a computer and application software for electrical and electronics engineering design		
GENERAL OBJECTIVES: On completion of this course, the students should be able to: 1.0 Understand how to diagnose simple faults on a computer 2.0 Understand how to carry out repairs on Computer 3.0 Understand the concept and principle of application software for electrical and electronic engineering design 4.0 Understand basic structure and function of python software 5.0 Understand MATLAB software		

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PROGRAMME: NATIONAL DIPLOMA IN ELECTRICAL AND ELECTRONICS ENGINEERING TECHNOLOGY						
COURSE TITLE: Computer Hardware and Software II			**COURSE CODE**: EEC 222		**CONTACT HOURS**: 3	
			CREDIT UNIT: 2		**THEORETICAL:** 1	
YEAR: II **SEMESTER:** II			**PRE-REQUISITE:**		**PRACTICAL:** 2	
COURSE SPECIFICATION: THEORETICAL AND PRACTICAL						
GOAL: This course is designed to equip students with knowledge and skills on how to diagnose and rectify simple faults on a computer and application software for electrical and electronics engineering design						
General Objective 1.0: Understand Computer Hardware Repairs						
THEORETICAL CONTENT				**PRACTICAL CONTENT**		
Week	Specific Learning Outcome	Teacher's Activities	Resources	Specific Learning Outcome	Teacher's Activities	Resources
	1.1 Explain the concept of system repairs 1.2 Describe the procedures involved for Computer Repairs 1.3 Explain how to repair common power supply issues. 1.4 Explain how to upgrade laptop components (RAM, SSDs, Wi-Fi cards). 1.5 Explain how to disassemble and repair	Explain the procedures involved for electronics/ computer repairs	Markerboard Marker Textbooks Computer Projector	Demonstrate how to carry out computer maintenance Repair common power supply issues. Upgrade laptop components (RAM, SSDs, Wi-Fi cards). Disassemble and repair a faulty motherboard. Upgrade components in a laptop or desktop to improve performance.	Guide students to: Demonstrate how to carry out computer maintenance Repair common power supply issues. Upgrade laptop components (RAM, SSDs, Wi-Fi cards). Disassemble and repair a faulty motherboard. Upgrade components in a laptop or desktop to	Desktop computer Laptops Toolbox

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	a faulty motherboard. 1.6 Explain how to upgrade components in a laptop or desktop to improve performance.				improve performance.	
General Objectives 2.0: Understand Computer Fault Diagnosis						
1-4	2.1 Explain computer software components 2.2 Explain computer hardware components. 2.3 Explain the basic concept of PC Troubleshooting 2.4 Explain Hardware Problems 2.5 Explain Operating System & Software Issues 2.6 Explain Networking & Internet Connectivity Troubleshooting	Explain the basic concept of PC Troubleshooting Explain Hardware Problems Explain Operating System & Software Issues Explain Networking & Internet Connectivity Troubleshooting Explain Virus & Malware Removal Preventative Maintenance & Optimization Explain Hands-on Troubleshooting	Markerboard Marker Textbooks Computer Projector	Identify computer hardware components Identify AT and ATX f power packs Identify different computer interface cables Assemble a Computer System. Disassemble a Computer System. Identify faults in the following: • Power supplies • System clocks • Memory Cards • Low battery • I/O ports, • Disk drives • Voltages • Keyboard	Guide students to: Identify computer hardware components Identify AT and ATX f power packs Identify different computer interface cables Assemble a Computer System. Disassemble a Computer System. Identify faults in the following: • Power supplies • System clocks • Memory Cards • Low battery • I/O ports, • Disk drives • Voltages	Computer auxiliary units Computer peripheral units Central processing units (CPU) I/O devices, tools and measuring instruments. Scraps of computer system. Memory cards Mother board

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	2.7 Explain Virus & Malware Removal 2.8 Explain computer preventative Maintenance & Optimization 2.9 Explain Hands-on Troubleshooting Techniques 2.10 Explain faults that relates the following: • Power supplies • System clocks • Memory Cards • Low battery • I/O ports, • Disk drives • Voltages • Keyboard • Monitors • Scratches on discs. 2.11 Explain the troubleshooting procedures for the	Techniques Explain faults that relates the following: • Power supplies • System clocks • Memory Cards • Low battery • I/O ports, • Disk drives • Voltages • Keyboard • Monitors • Scratches on discs. Explain the troubleshooting procedures for the following computer faults: • Overheating • Slow performance • Blue screen of Death • Internet connectivity issues • Malware • Frozen screen • Power issues • Software crashes • Peripheral		• Monitors • Scratches on discs Rectify the following faults: • Overheating • Slow performance • Blue screen of Death • Internet connectivity issues • Malware • Frozen screen • Power issues • Software crashes • Peripheral device issues • Ram (memory) issues • Unable to boot • Applications won't install • CPU problems • Data loss issues • Dropped internet connections	• Keyboard • Monitors • Scratches on discs Rectify the following faults: • Overheating • Slow performance • Blue screen of Death • Internet connectivity issues • Malware • Frozen screen • Power issues • Software crashes • Peripheral device issues • Ram (memory) issues • Unable to boot • Applications won't install • CPU problems • Data loss issues • Dropped internet connections	

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	following computer faults: • Overheating • Slow performance • Blue screen of Death • Internet connectivity issues • Malware • Frozen screen • Power issues • Software crashes • Peripheral device issues • Ram (memory) issues • Unable to boot • Applications won't install • CPU problems • Data loss issues • Dropped internet connections 2.12 Explain the steps to rectify the faults in 1.8 and 1.9. 2.13 Explain harmful software and security threats detection and	device issues • Ram (memory) issues • Unable to boot • Applications won't install • CPU problems • Data loss issues • Dropped internet connections Explain the steps to rectify the faults in 1.8 and 1.9. Explain harmful software and security threats detection and elimination				

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	elimination					
General Objective 3.0: Understand basic structure and function of python software						
8-11	3.1 Define software. 3.2 List of application software in electrical engineering. 3.3 Explain the uses of application software 3.4 Define python and its functions 3.5 Explain python syntax compared to other programming languages 3.6 Explain the basic syntax, indentation and comments in python 3.7 Explain different types of python data: • Integer (int)	Explain python and its functions Explain python syntax compared to other programming languages Explain the basic syntax, indentation and comments in python Explain the different types of python data: • Integer (int) • Float • String • Boolen Explain python data structure and characteristics Explain python	Markerboard Marker Textbooks Computer Projector	Demonstrate indentation and comments in python Demonstrate different types of python data Demonstrate functions associated with numpy Demonstrate the use of numpy library Create table and classes Manipulate the usual functions associated with numpy in python Demonstrate the pandas library Demonstrate how to build and manipulate a data frame	Guide students to: Demonstrate indentation and comments in python Demonstrate different types of python data Demonstrate functions associated with numpy Demonstrate the use of numpy library Create table and classes Manipulate functions associated with numpy in python Demonstrate the pandas library Demonstrate how to build and manipulate a	Computers with installed python software

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	• Float • String • Boolen 3.8 Explain python data structure and characteristics 3.9 Explain python numpy 3.10 Define table in python 3.11 Explain the main operations used in numpy tables 3.12 Explain pandas library 3.13 Explain algorithms in python 3.14 Define search and sorting	numpy Define table in python Explain the main operations used in numpy tables Explain pandas library Explain algorithm in python • Define search and sorting		Identify the main algorithm of python	data frame Identify the main algorithm of python	

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General Objective 4.0: Understand **MATLAB** software						
12-15	4.1 Define MATLAB and its function 4.2 Explain how to start MATLAB 4.3 Describe how to use MATLAB as a calculator 4.4 Define the following: • Matrices • Arrays • Columns of data 4.5 Explain the basic syntax, indentation and comments in MATLAB 4.6 Explain different types of MATLAB data: • Integer (int) • Float • String • Boolean	Explain MATLAB and its function Explain the startup of MATLAB Explain how to use MATLAB as a calculator Explain the following: • Matrices • Arrays • Columns of data Explain the basic syntax, indentation and comments in MATLAB Explain different types of MATLAB data: • Integer (int) • Float • String	Markerboard Marker Textbooks Computer Projector	Demonstrate the launch of MATLAB Demonstrate MATLAB window as a calculator Demonstrate the following in MATLAB windows library Demonstrate the following data in MATLAB window • Integer (int) • Float • String • Boolean Simulate an RLC circuit using MATLAB	Guide students to: Demonstrate the launch of MATLAB Demonstrate MATLAB window as a calculator Demonstrate the following in MATLAB windows library Demonstrate the following data in MATLAB window • Integer (int) • Float • String • Boolean Simulate an RLC circuit using MATLAB	Computers with MATLAB software

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		• Boolean				
ASSESSMENT: The practical class will be awarded 60% of the total score. The continuous assessments, test and quizzes will cover 10% of the total score, while the remaining 30% will be for the end of the semester examination**.**						

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PROGRAMME: NATIONAL DIPLOMA IN ELECTRICAL AND ELECTRONICS ENGINEERING TECHNOLOGY		
COURSE TITLE: Electronics III	**COURSE CODE:** EEC 223	**CONTACT HOURS:** 4
	CREDIT UNIT: 3	**THEORETICAL:** 1
YEAR: II **SEMESTER: II**	**PRE-REQUISITE:** EEC 213	**PRACTICAL:** 2
GOAL: This course is designed to equip the student with the knowledge and skills of passive and active electronic components and their applications.		
GENERAL OBJECTIVES: At the end of the course the student should be able to: 1.0 Understand the nature of feedback in relation to amplifier 2.0 Understand controllers and controller design 3.0 Understand Oscillators and Multivibrators in electronic circuits 4.0 Know power converters and their applications		

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Electronics III

PROGRAMME: NATIONAL DIPLOMA IN ELECTRICAL AND ELECTRONICS ENGINEERING		
COURSE TITLE: Electronics III	**COURSE CODE:** EEC 223	**CONTACT HOURS:** 4
	CREDIT UNIT: 3	**THEORETICAL:** 1
YEAR: II **SEMESTER:** II	**PRE-REQUISITE:** EEC 213	**PRACTICAL:** 2
COURSE SPECIFICATION: THEORETICAL AND PRACTICAL		
GOAL: This course is designed to equip the student with the knowledge and skills of passive and active electronic components and their applications.		
General Objective 1.0: Understand the nature of feedback in relation to amplifier		

	THEORETICAL CONTENT			**PRACTICAL CONTENT**		
Week	**Specific Learning Outcome**	**Teachers' Activities**	**Resources**	**Specific Learning Outcome**	**Teachers' Activities**	**Resources**
1-3	1.1 Describe Input and Output of a system in an amplifier in relation to: • Voltage • Current • Gain 1.2 Explain the general nature of positive and negative feedback in a system. 1.3 Prove that the GAIN of a system is mainly determined by the	Explain Input and Output of a system in an amplifier in relation to: • Voltage • Current • Gain Explain the general nature of positive and negative feedback in a system. Explain how to prove that the GAIN of a system is mainly determined by the	Textbooks Journals Whiteboard Marker Charts Animations Computer Projector	Investigate the effect of applying negative feedback on a distorted signal, input, output and impedances of negative feedback on an amplifier.	Guide students to Investigate the effect of applying negative feedback on a distorted signal, input, output and impedances of negative feedback of an amplifier	Oscilloscope Oscillators Operational amplifiers Multi-vibrator Voltmeter Ammeter Cables

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	feedback function and independent of forward gain. 1.4 Describe the general expression for stage gain of a basic feedback in an amplifier 1.5 Describe effect of applying negative feedback to an amplifier in relation to: • Gain • Gain stability • Bandwidth • Distortion • Noise • Input and output resistance in a qualitative method 1.6 State the advantages and disadvantages of negative feedback to an amplifier circuit	feedback function and independent of forward gain. Explain the general expression for stage gain of a basic feedback in an amplifier Explain the effect of applying negative feedback to an amplifier in relation to: • Gain • Gain stability • Bandwidth • Distortion • Noise • Input and output resistance in a qualitative method Explain the advantages and disadvantages of negative feedback to an amplifier circuit				Power source Electronic trainer.
General Objective 2.0: Understand Controllers and Controller design						

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4-8	2.1 Define Controller 2.2 Explain the types of Controllers 2.3 Explain the importance of Controllers to electronic circuits 2.4 Explain the properties of a Proportional Integral and Derivative (PID) Controller 2.5 Explain the applications of PID Controller: • Temperature PID Controller • Tension PID Controller.	Explain Controller Explain the types of Controllers Explain the importance of Controllers to electronic circuits Explain the properties of a Proportional Integral and Derivative (PID) Controller Explain the applications of PID Controller. • Temperature PID Controller • Tension PID Controller.	Textbooks Journals Whiteboard Marker Charts Animations Computer Projector	Design a controller with simple control system configuration	Guide students to: Design a controller with simple control system configuration	Breadboard Computers with appropriate software PID controller.

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General Objective 3.0: Understand Oscillators and Multivibrators in electronic circuits						
9-10	3.1 Define Oscillators 3.2 Explain the working principles of oscillators 3.3 Explain the functions of Oscillators 3.4 Explain how oscillators can be produced by an amplifier with positive feedback. 3.5 Explain the operation of: • C oscillator • L-C oscillator (Hartley & Colpitts Oscillators) 3.6 Describe methods of achieving frequency stability of oscillators as in piezo-electric crystal	Explain Oscillators Explain the working principles of oscillators Explain the functions of Oscillators Explain how oscillators can be produced by an amplifier with positive feedback. Explain the operation of: • C oscillator • L-C oscillator (Hartley & Colpitts Oscillators) Explain methods of achieving frequency stability of oscillators as in piezo-electric crystal	Textbooks Journals Whiteboard Marker Charts Animations Computer Projector	Measure the frequency and amplitude of a sinusoidal signal of an LC-Colpitts oscillator. Measure the frequency and amplitude of an output generated signal. Carryout experiment to investigate the factors which affect the operation of LC Hartley oscillator and measure the frequency and amplitude of a generated signal Carryout an	Guide students to: Measure the frequency and amplitude of a sinusoidal signal of an LC Colpitts oscillator. Measure the frequency and amplitude of an output generated signal. Carryout experiment to investigate the factors which affect the operation of LC Hartley oscillator and measure the frequency and amplitude of a generated signal Carryout an experiment to determine the factors which influence the operation of	Oscilloscope Oscillators Op-amp Ammeter Cable Voltmeter Multivibrator.

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	3.7 Define with the aid of suitable sketches the operation of multivibrators 3.8 Explain the types of Multivibrators 3.9 Explain with the aid of suitable sketches the operation of multivibrators 3.10 State the applications of multivibrators circuits. 3.11 Explain how to solve simple problems on multivibrators.	Explain with the aid of suitable sketches the operation of multivibrators Explain the applications of multivibrators circuits Explain with the aid of suitable sketches the operation of multivibrators Explain the applications of multivibrators circuits Explain how to solve simple problems on multivibrators.		experiment to determine the factors which influence the operation of transistorized monostable, bistable and astable multivibrators. Carryout an experiment to determine both the input and output waveforms of a bridge rectifier and the effects of different filter circuits Build a circuit consisting of 555 multivibrator to determine 50% duty cycle square wave output signal	transistorized monostable, bistable and astable multivibrator Perform experiment to observe and measure both the input and output waveforms of a bridge rectifier and the effects of different filter circuits Build a circuit consisting of 555 multivibrator to determine 50% duty cycle square wave output signal	
General Objective 4.0: Know power converters and their applications						
11-15	4.1 Define power converters	Explain power converters Explain the types of	Textbooks Journals Whiteboard	Sketch a block diagram	Guide students to: Sketch a block diagram representation of a	Sample converter Oscilloscope

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	4.2 Explain the types of power converters and inverters 4.3 Explain the working principles of power converters 4.4 Explain frequency converter as a special type of power converter 4.5 Explain the applications of power converters	power converters and inverters Explain the working principles of power converters Explain frequency converter as a special type of power converter Explain the applications of power converters	Marker Charts Animations Computer Projector	representation of a converter with its components Measure the input and output current and voltage levels of a converter and determine the frequency waveforms	converter with its components Measure the input and output current and voltage levels of a converter and determine the frequency waveforms	Multimeter Power source.
ASSESSMENT: Assessment: The practical class will be awarded 60% of the total score. The continuous assessments, tests and quizzes will be 10% the total score, while the remaining 30% will be for the end of semester examination						

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Electric Circuit Theory II

PROGRAMME: NATIONAL DIPLOMA IN ELECTRICAL AND ELECTRONICS ENGINEERING TECHNOLOGY		
COURSE TITLE: Electric Circuit Theory II	**COURSE CODE:** EEC 224	**CONTACT HOURS:** 3
	CREDIT UNIT: 2	**THEORETICAL:** 1
YEAR: II **SEMESTER:** II	**PRE-REQUISITE:** EEC 214	**PRACTICAL:** 2
GOAL. This course is designed to equip the students with the knowledge and skills of Electrical circuit theorems and network analysis of multiphase systems		

GENERAL OBJECTIVES: On completion of this course, the students should be able to:

1.0 Understand the principle of power calculation in a.c circuits.
2.0 Understand the basic principles of three-phase systems.
3.0 Know time domain analysis of RC and RL circuits.
4.0 Understand the concept of magnetic coupling.

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PROGRAMME: NATIONAL DIPLOMA IN ELECTRICAL AND ELECTRONICS ENGINEERING TECHNOLOGY						
COURSE TITLE: Electric Circuit Theory II		**COURSE CODE:** EEC 224		**CONTACT HOURS:** 3		
		CREDIT UNIT: 2		**THEORETICAL:** 1		
YEAR: II **SEMESTER:** II		**PRE-REQUISITE:** EEC 214		**PRACTICAL:** 2		
COURSE SPECIFICATION: THEORETICAL AND PRACTICAL						
GOAL: This course is designed to equip the students with thew knowledge and skills of Electrical circuit theorems and network analysis of multiphase systems						
General Objective 1.0: Understand the principle of power calculation in a.c circuits.						
THEORETICAL CONTENT				**PRACTICAL CONTENT**		
Week	**Specific Learning Outcome**	**Teachers' Activities**	**Resources**	**Specific Learning Outcome**	**Teachers' Activities**	**Resources**
1-3	1.1 Explain how to calculate power in a.c. circuits containing: • Resistance • Inductance • Capacitance Combinations of (a.)-(c) 1.2 Explain the following terms: • Apparent power • Reactive power	Solve problems involving power in A.C. circuits containing active and reactive elements and the combination of both. Explain the following terms: • Apparent power • Reactive power	Textbooks Journals Markers Whiteboard Charts Animations Calculators Projectors,	Demonstrate the effect of the step-down transformer. Carryout Continuity Test on a Single Phase Transformer. Carryout experiment on the turns ratio of a transformer	Guide students to: Demonstrate the effect of the step-down transformer. Carryout Continuity Test on a Single Phase Transformer. Carryout experiment on the turns ratio of a transformer	Transformer Insulation - resistance tester Multimeter Power source

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	• Power factor and factors affecting its values • Apparent power, active and reactive power • Methods of power factor correction 1.3 Explain methods of power factor correction. 1.4 Explain how to solve problems on power factor, active power, apparent power, reactive power and power factor correction.	• Active power. • Power factor and factors affecting its values • Apparent power, active • Methods of power factor correction Explain methods of power factor correction Explain how to solve as many numerical problems as possible on power factor, active, power, apparent power, reactive power and power factor correction.				
General Objective 2.0: Understand the basic principles of three-phase systems						
4-7	2.1 Define polyphase system 2.2 Explain the basic principles of polyphase power systems. 2.2 Explain difference between single phase, two	Explain polyphase Explain the basic principles of polyphase power systems. Discuss the three-phase system versus single-	Textbooks Journals Markers Whiteboard Charts Animations Calculators Projectors	Measurement of voltage and current. Carryout continuity test in three phase transformer.	Guide students to: Measurement of voltage and current. Carryout continuity test in three phase transformer.	Transformer Multimeter Insulation – resistance tester Power source

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	phase and three-phase systems 2.3 Define the phase sequence of a three phase system. 2.4 Explain the advantages of 3-phase circuits. 2.5 Explain how 3-phase emf's are produced 2.6 Differentiate between star and delta 3phase system with their corresponding merits and demerit. 2.7. Derive the relationship between line and phase values of voltages and current in a star & delta connected windings. 2.8 Derive an expression for power in a 3phase circuit (balanced and	phase system. Explain the phase sequence of a three phase system. Explain the advantages of 3-phase circuits. Explain how 3-phase emf's are produced Explain the differences between star and delta 3phase system with their corresponding merits and demerit. Explain the relationship between line and phase values of voltages and current in a star and delta connected windings. Analyse an expression for power in a 3phase circuit (balanced and unbalanced).		Demonstrate terminals of three phase transformer. Demonstrate Three phase star connected circuits.	Demonstrate terminals of three phase transformer. Demonstrate Three phase star connected circuits	

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	unbalanced). 2.9 Explain the 2-wattmeter and single wattmeter methods of measuring 3-phase power. 2.10 Explain how to solve as many problems as possible on 2.5 to 2.9 above. 2.11 Explain smart grid concepts related to three-phase power systems. 2.12 Explain the Impact of unbalanced loads in a three-phase system	Discuss the 2-wattmeter and single wattmeter methods of measuring 3-phase power. Explain how to solve as many problems as possible on 2.5 to 2.9 above. Explain smart grid concepts related to three-phase power systems. Explain the Impact of unbalanced loads in a three-phase system				
General Objective 3.0: Know time domain analysis of RC and RL circuits						
8-11	3.1 Explain transients 3.2 Explain the growth and decay curves in RC circuits. 3.3 Explain how to derive formulae for current &	Explain transients Explain the growth and decay curves in RC circuits. Explain how to derive formulae for current &	Textbooks Journals Markers Whiteboard Charts Animations Calculators, Projectors,	Demonstrate three phase delta connected circuits. Sketch the growth and decay curves in RC circuits.	Guide the students to: Demonstrate three phase delta connected circuits Sketch the growth and decay curves in	Electronic trainer Energy meter Multimeter Motor starters Electric

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	voltage growth and decay in RC circuits. 3.4 Define time constant 3.5 Explain time constant in RC circuits. 3.6 Explain how to derive expressions for the growth and decay of voltage and current in RL circuits. 3.7 Explain curves for growth and decay of current and voltage in RL circuits. 3.8 Explain the need for connecting a resistor in parallel with an inductor. 3.9 Explain how to solve problems involving transient in RC and RL.	voltage growth and decay in RC circuits. Explain time constant Explain time constant in RC circuits. Explain how to derive expressions for the growth and decay of voltage and current in RL circuits. Explain curves for growth and decay of current and voltage in RL circuits. Explain the need for connecting a resistor in parallel with an inductor. Explain how to solve problems involving transient in RC and RL.		Sketch curves for growth and decay of current and voltage in RL circuits. Demonstrate three phase power measurement using two wattmeter method. Demonstrate starting method of three-phase induction motors, Direct on-line starting method. Measure the electrical quantities of 3-phase induction motor.	RC circuits. Sketch curves for growth and decay of current and voltage in RL circuits. Demonstrate three phase power measurement using two wattmeter method. Demonstrate starting method of three-phase induction motors, Direct on-line starting method. Measure the electrical quantities of 3-phase induction motor	motor

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	3.10 Explain damping and oscillatory responses of RLC circuits for real-world signal processing applications.	Explain damping and oscillatory responses of RLC circuits for real-world signal processing applications.				
General Objective 4.0: Understand the concept of magnetic coupling phenomena.						
12– 15	4.1 Define magnetic coupling 4.2 Define mutual Inductance 4.3 Explain the polarity of coupled coils. 4.4 Explain coefficient of coupling 4.5 Explain equivalent circuit for magnetically coupled coils. 4.6 Define an ideal transformer 4.7 Use 4.5 to derive an equivalent circuit of an ideal transformer.	Explain magnetic coupling. Explain mutual Inductance. Explain the polarity of coupled coils Explain coefficient of coupling. Explain an equivalent circuit for magnetically coupled coils. Explain the concept of an ideal transformer. Use equivalent circuit for magnetically coupled coils to derive an	Textbooks Journals Markers Whiteboard Charts Animations Calculators Projectors	Determine three -phase Induction motor under load. Determine Torque – Current Characteristic Connect the 3-phase dual speed squirrel cage induction motor'. Carryout experiment on Induction motor Determine the polarity of coupled coils. Find equivalent circuits for magnetically coupled coils.	Guide the students to: Determine three -phase Induction motor under load. Determine Torque – Current Characteristic Connect the 3-phase dual speed squirrel cage induction motor'. Carryout experiment on Induction motor Determine the polarity of coupled coils.	Induction motor Multimeter Electronic trainer

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		equivalent circuit of an ideal transformer			Find equivalent circuit for magnetically coupled coils.	
	4.8 Explain with the aid of sketches, an equivalent circuit of a practical transformer.	Explain with the aid of sketches, an equivalent circuit of a practical transformer.				
	4.9 Explain magnetic coupling in resonant circuits for wireless communication.	Explain magnetic coupling in resonant circuits for wireless communication.				
	4.10 Explain transformer equivalent circuit analysis in high-efficiency power systems.	Explain transformer equivalent circuit analysis in high-efficiency power systems.				
EVALUATION: The continuous assessment; tests and quizzes will be awarded 60% of the total score. The end of the Semester Examination will make up for the remaining 40% of the total score.						

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Introduction to Industrial Automation

PROGRAMME: NATIONAL DIPLOMA IN ELECTRICAL AND ELECTRONICS ENGINEERING TECHNOLOGY		
COURSE TITLE: Introduction to Industrial Automation	**COURSE CODE:** EEC 225	**CONTACT HOURS:** 4
	CREDIT UNIT: 3	**THEORETICAL:** 2
YEAR: II **SEMESTER:** II	**PRE-REQUISITE:**	**PRACTICAL:** 2
GOAL: This course is designed to acquaint students with the knowledge and skills of industrial automation systems.		
GENERAL OBJECTIVES: On completion of this course, the students should be able to: 1.0: Understand Automation Systems 2.0 Understand Programmable Logic Controller 3.0 Know PLC Software and Programming Tools 4.0: Understand PLC fault diagnosis and troubleshooting principles including software tools 5.0 Understand Robotics System 6.0 Understand Mechatronics System 7.0: Know how to use Human-Machine Interfaces (HMI)		

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PROGRAMME: NATIONAL DIPLOMA IN ELECTRICAL AND ELECTRONICS ENGINEERING TECHNOLOGY					
COURSE TITLE: Introduction to Industrial Automation		**COURSE CODE:** EEC 225		**CONTACT HOURS:** 4	
		CREDIT UNIT: 3		**THEORETICAL:** 2	
YEAR: II **SEMESTER:** II		**PRE-REQUISITE:**		**PRACTICAL:** 2	
COURSE SPECIFICATION: THEORETICAL AND PRACTICAL					
GOAL: This course is designed to acquaint students with the knowledge and skills of industrial automation systems.					
General Objective 1.0: Understand Automation System					
THEORETICAL CONTENT				PRACTICAL CONTENT	
Week	Specific Learning Outcome	Teacher's Activities	Resources	Specific Learning Outcome	Teacher's Activities	Resources
1-2	1.1 Explain the basic concept of Automation. 1.2 Enumerate types of Automation. 1.3 Define the following: • Home automation • Industrial automation • Cognitive automation 1.4 Explain the elements of the following: • Home Automation • Industrial Automation	Explain the basic concept of Automation. Explain types of Automation. Explain the following: • Home automation • Industrial automation • Cognitive automation Explain the elements of the following:	Whiteboard Markers Textbooks Journals Projector	Identify: • Home Automation • Industrial Automation Identify the elements of the following: • Home Automation Industrial Automation	Guide Student to: Identify: • Home Automation • Industrial Automation Identify the elements of the following: • Home Automation Industrial Automation	Videos and Pictures.

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	• Cognitive automation 1.5 Explain structure and Hierarchy of the following: • Home Automation • Industrial Automation • Cognitive automation 1.6 Explain Safety in automation in 2.5. 1.7 List Manufacturing and Process Industry Automation Equipment 1.8 State the Advantage and Disadvantages of Industrial Automation.	• Home Automation • Industrial Automation • Cognitive automation Explain structure and Hierarchy of the following: • Home Automation • Industrial Automation • Cognitive automation Explain Safety in automation in 2.5. Explain Manufacturing and Process Industry Automation Equipment Explain the Advantage and Disadvantages of Industrial Automation.				
General Objective 2.0: Understand Programmable Logic Controller						
3-4	1.1 Explain the history of programmable logic	Explain the history of programmable logic	Whiteboard Markers	Identify the parts of a programmable logic	Guide students to:	PLC Simulator

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	controllers (PLC) and its major manufacturers 1.2 Explain parts of a programmable logic controller 1.3 State the PLC hardware devices. 1.4 Explain PLC logic functions 1.5 Explain signal Modules and Other Peripherals 1.6 Explain basic concept of signal conditioning. 1.7 List different types of analog signals used in PLC system: Voltage signal (0..5V, 0..10V, -5..5V) Current signal (0..20mA, 4..20mA) 1.8 Explain the function of	controllers (PLC) and its major manufacturers Explain parts of a programmable logic controller Explain the PLC hardware devices. Explain the PLC Logic functions Explain signal Modules and Other Peripherals Explain basic concept of signal conditioning. Explain different types of analog signals used in PLC system: • Voltage signal (0..5V, 0..10V, -5..5V) • Current signal	PLC internal architecture block drawings Textbooks Journals Projector	controller Identify the types of Input/output devices Identify expansion modules and boards Connect and program different types of sensors and actuators. Connect different analog signals. Connect the following to the PLC: • On/Off sensors • Analog sensors • Switches • Actuators • Valves • Drives Turn on a motor or lamp using two buttons applying latching logic	Identify the parts of a programmable logic controller Identify the types of Input/output devices Identify expansion modules and boards Connect and program different types of sensors and actuators. Connect different analog signals. Connect the following to the PLC: • On/Off sensors • Analog sensors • Switches • Actuators • Valves • Drives	PCs PLC device with training board Manual switches for inputs. Variety of PLCs and expansion modules and boards. PLC simulator

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	digital input and output modules. 1.9 Explain the integration of different types of sensors and actuators with PLCs. 1.10 Explain the role of analog I/O modules in PLCs 1.11 Explain SCADA and Data Acquisition systems 1.12 Explain the differences between SCADA, DCS (Distributed Control Systems), and PLC-based control systems. 1.13 Describe the hardware components: RTUs (Remote Terminal Units), PLCs, sensors, and actuators. 1.14Explain the following PLC communication	(0..20mA, 4..20mA) Explain the function of digital input and output modules. Explain the integration of different types of sensors and actuators with PLCs. Explain the role of analog I/O modules in PLCs Explain SCADA and Data Acquisition systems Explain differences between SCADA, DCS (Distributed Control Systems), and PLC-based control systems. Describe the hardware components: RTUs (Remote Terminal Units), PLCs, sensors, and		Turn off a motor or lamp using two buttons applying latching logic	Turn on a motor or lamp using two buttons applying latching logic Turn off a motor or lamp using two buttons applying latching logic	

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	protocols • Modbus, • Profibus • ProfiNet • Ethernet/IP .	actuators. Explain the following PLC communication protocols •Modbus, •Profibus •ProfiNet •Ethernet/IP				
General Objective 3.0: Know PLC Software and Programming Tools						
5-6	3.1 Define a PLC program 3.2 Explain the following. • Programming Instructions • Programming software 3.3 Explain the major features of IEC 61131-3 standard programming languages: • Ladder logic • Structured text • Function block diagrams	Explain the following: • Programming Instructions • Programming software Explain the major features of IEC 61131-3 standard programming languages: • Ladder logic • Structured text • Function block diagrams	Whiteboard and markers, PLC Textbooks Journals Projector.	Make a program in ladder diagram Translate a ladder diagram program into electrical and logic circuits equivalent. Carry out basic Timer operations Carry out basic counter operations Download and Upload programs to/from a CPU using PLC software	Guide students to: Make a program in ladder diagram Translate a ladder diagram program into electrical and logic circuits equivalent. Carry out basic Timer operations Carry out basic counter operations Download and	PLC Simulators PCs

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	3.4 Explain how a PLC scans a program and how the scan relates to input and output data table registers. 3.5 Explain the PLC program terminals 3.6 Explain the uses of 'Main' and 'Init' program files 3.7 Explain PLC Ladder diagrams 3.8 Explain the Function Block Diagram 3.9 Explain how to make a program in ladder diagram 3.10 Explain how to translate a ladder diagram program into electrical and logic	Explain how a PLC scans a program and how the scan relates to input and output data table registers. Explain the PLC program terminals Explain the uses of the 'Main' and 'Init' program files Explain PLC Ladder diagrams Explain the Function Block Diagram Explain how to make a program in ladder diagram Explain how to translate a ladder diagram program into electrical and logic circuits equivalent.			Upload programs to/from a CPU using PLC software	

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	circuits equivalent. 3.11 Explain Timers and Counter applications 3.12 Explain how to download and Upload programs to/from a CPU using PLC software	Explain Timers and Counter applications Explain how to download and Upload programs to/from a CPU using PLC software.				
General Objective 4.0: Understand PLC fault diagnosis and troubleshooting principles including software tools						
9-11	4.1 Explain status light on a PLC or CPU module indicators 4.2 Describe the advantages of using PLC error codes and how they are displayed on a PLC 4.3 Describe techniques for diagnosing faults in PLC systems.	Explain status light on a PLC or CPU module indicators Explain the advantages of using PLC error codes and how they are displayed on a PLC Explain techniques for diagnosing faults in PLC systems. Explain diagnostic	Whiteboard Markers PLC Textbooks Journals Projector	Interpret what each status light on a PLC or CPU module indicates. Interpret PLC error codes. Practice resolving common hardware and software issues.	Guide students to: Interpret what each status light on a PLC or CPU module indicates. Interpret PLC error codes. Practice resolving common hardware and software issues.	PLC Simulator PCs

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	3.13 4.4 Explain diagnostic tools and software for troubleshooting.	tools and software for troubleshooting.				
General Objective 5.0: Understand Robotics System						
12-13	5.1 Define a robot 5.2 Explain the basic concept of robotics. 5.3 Explain the Laws of Robotics 5.4 List the Different Types of Robots. 5.5 List Robot Part and Explain their functions. 5.6 Explain Robot Technical Specification. 5.7 Describe the following: • Robot Anatomy • Kinematics • Mechanisms • Drive Systems • Robot Sensors • Vision Systems • Voice Recognition	Explain the term robot Explain the basic concept of robotics. Explain the Laws of Robotics Explain different types of Robots. List Robot Part and Explain their functions. Explain Robot Technical Specification. Describe the following: • Robot Anatomy • Kinematics • Mechanisms • Drive Systems • Robot Sensors • Vision Systems • Voice	Whiteboard and markers, PLC Textbooks Journals Projector.	Identify components of robot based on configuration and application.	Guide the student to Identify components of robot based on configuration and application.	Pictures and videos

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	5.7 Explain the basic concept of robot Control. 5.8 Explain Safety in Robotics. 5.9 Explain the Application of Robotics.	Recognition Explain the basic concept of robot Control. Explain Safety in Robotics. Explain the Application of Robotics.				
General Objective 6.0: Understand Mechatronics System						
14	6.1 Define Mechatronics. 6.2 List different mechatronics system. 6.3 Explain Mechatronics system primary elements. 6.4 Explain the applications of mechatronics system. 6.5 Define a System. 6.6 Explain different	Explain different mechatronics system. Explain Mechatronics system primary elements. Explain the applications of mechatronics system. Explain different types of systems Explain the function of each type in 1.6.	Whiteboard Markers PLC Textbooks Journals Projector	Identify household items that can be characterized as mechatronic System. Identify components the task above that help identify them as mechatronic Systems. Identify the characteristics of the following: • LVDT • Variable Capacitor. • Light Dependent	Guide students to: Identify household items that can be characterized as mechatronic System. Identify components the task above that help identify them as mechatronic Systems. Identify the characteristics	Instrumental diagrams Training board Plug-in- cables Dc power source Washing machine Bread toaster and Hand drilling Machine. Transducer Trainer LVDT. Variable Capacitor.

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	types of systems 6.7 State the function of each type in 1.6. 6.8 Explain the following: • Transducer • Sensors • Actuators 6.9 Explain the different types of transducers, sensors and actuators 6.10 Explain the applications of sensors, transducer and actuators.	Explain the following: • Transducer • Sensors Explain the different types of transducers and sensors Discuss the applications of sensors and transducer. Explain the applications of sensors, transducer and actuators.		Resistor • Resistance Temperature Detector • Thermistor. • Thermocouple. Identify different drives	of the following: • LVDT • Variable Capacitor. • Light Dependent Resistor • Resistance Temperature Detector • Thermistor. • Thermocouple. Identify different drives	Light Dependent Resistor. Resistance Temperature Detector. Thermistor. Thermocouple. AC and DC motors
General Objective 7.0: Know how to use Human-Machine Interfaces (HMI)						
15	7.1 Describe HMIs and their interaction with PLCs. 7.2 Explain how to design and program a basic HMI for a PLC system.	Explain HMIs and their interaction with PLCs. Explain how to design and program a basic HMI for a PLC system.	Whiteboard Markers PLC Textbooks Journals Projector	Program a basic HMI for a PLC system.	Guide students to: Design and program a basic HMI for a PLC system.	PLC device with training board equipped with manual switches for digital inputs. HMI panel. PLC

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	6.11					& HMI programming software (depends on PLC platform: TIA Portal, MELSEC, TwidoSuite, Studio 5000 Logix Designer)

EVALUATION: 60%

EXAMINATION: 40%

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Algebra And Elementary Trigonometry MTH 112	1. Establish the laws of Indices. 2. Solve problems using the laws of indices 3. Solve simple logarithms problem. 4. Apply knowledge from 3.1in termination as laws from experimental data. 5. Ask the students to draw graphs. 6. Solve quadratic equation by factorisation. 7. Solve set theory problems using Venn diagrams. 8. Obtain the formula for nth term and the first n terms of an A. P. 9. Ask the students to apply progression to solve problems. 10. Apply the techniques of vectors to solve various problems 11. Apply the parallelogram law in solving problems including addition and subtraction of vectors. 12. Compute the resultant of coplanar forces acting at a point using algebraic and graphical method 13. Apply the techniques of resolution and resultant to the solution of problems involving coplanar forces.

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	14. Apply vectorial techniques in solving problems involving relative velocity. 15. Compute the scalar product of given vectors. 16. Compute the scalar product of given vectors. 17. Calculate the direction ratios of given vectors. 18. Calculate the angle between two vectors using the scalar product 19. Solve carious equations as indicated in section 10. 20. Apply algebraic and graphical methods in solving two simultaneous equations a linear equation and a quadratic equation 21. Apply the algebraic and graphical methods in solving two simultaneous and quadratic equations. 22. Apply determinants of order 2 and 3 in solving simultaneous linear equations.
Technical Drawing MEC 111	1) Identify the different types of drawing instruments, equipment and materials. 2) Observe the precautions necessary to preserve the items identified above. 3) Use each of the items mentioned above. 4) Maintain the various instruments and

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	equipment. 5) Illustrate the various conventions present in graphical productions of construction lines, finished lines, hidden and overhead details projections, centre lines, break lines, dimensioning of plane, elevation and sections of objects. 6) Prepare drawing sheets with the following: • Margins • Title block etc. 7) State the various standards of drawing sheets. 8) Print letters and figures of various forms and characters. 9) Illustrate conventional signs, symbols and appropriate lettering characters. 10) Construct parallel and perpendicular lines. 11) Construct and bisect lines, angles and areas. 12) Divide a straight line into given number of equal parts. 13) Identify polygons (regular or irregular). 14) Construct regular polygons with N sides in a given circle, given: • Distance across flats

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	• Distance across corners. 15) Carryout simple geometrical constructions on circles e.g.: • Diameter of a circle of a circle of a given circumference. • The circumference to a circle of a given diameter • A circle to pass through 3 points • A circle to pass through 2 points and touch a given line • A circle to touch a given smaller circle and a given line • Tangents to circles at various points • An arc of radius tangent • To two lines at an angle to less than and more than 90 • An arc externally tangent to two circles: inscribing and circumscribing circles 16) Construct ellipse by using: • Trammel method • Concentric circle method. 17) Construct plane scales and diagonal scales, using appropriate instruments. 18) Draw a square in isometric and oblique

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	forms. 19) Draw a circle in Isometric and oblique forms. 20) Draw an ellipse in Isometric and oblique forms. 21) Draw a polygon with a minimum of eight sides in Isometric and oblique forms. 22) Dimension holes, circles, arcs and angles correctly on isometric and oblique projections. 23) Use appropriate convention symbols and abbreviations. 24) Project views of three-dimensional objects on to the basic planes of projection in both first and third angle to obtain: • The front view or elevation • The top view or plan. • The side view 25) Draw the lines of intersections of the following regular solids and planes in both first and third angles: • Two square-prisms meeting at right angles. • Two dissimilar square prisms meeting at an angle. • Two dissimilar square prisms

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	meeting to an angle • A hexagonal prism meeting a square prism at right angles. • Two dissimilar cylinders meeting at an angle. • Two dissimilar cylinders meeting at right angle, their centres not being in the same vertical plane
Basic Workshop Practice and Technology MEC 113	1) Demonstrate all safety rules and regulations in the workshop 2) Use safety equipment and Personal Protection Equipment 3) Follow safety procedures and precautionary measures 4) Inspect the following equipment in the workshops: • Air receivers • Ropes and Chains • Pulley blocks • Forklift carriage • Mobile and overhead cranes • Derricks and gantries 5) Differentiate between: • Hand tools and machine

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	tools • Bench tools and machine cutting tools 6) Identify marking out tools used on the bench typical workshop practical exercises. 7) Use marking-out tools on the bench correctly 8) Identify this bench cutting tools 9) Produce simple objects using bench/hand tools such as: • Files • Chisels • Scrapers • Saws etc. 10) Maintain files, dividers, saws, gauges try squares, bevel edge square etc. 11) Write process sheet or operation layout for the component to be produced. 12) Identify the differences and similarities between measuring and testing equipment in mechanical workshop with regards to: • Principle of operation • Construction • Use 13) Perform simple measuring exercises

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	using steel rules, vernier calipers and micrometers. • Use dial indicators to: • Set up jobs on the lathe • Roundness testing etc. 14) Carry out exercises involving flatness, squareness, straightness and surface finish test. 15) Perform taper measurement on jobs using vernier protractor and sine bars. 16) Inspect jobs using simple comparators Operate different types of drilling machine 17) Carry out drilling operations such as: • Counter-boring • Counter-sinking 18) Grind drill bits accurately 19) Select correct drilling speeds 20) Indicate the nomenclature of a twist drill: • Clearance angle • Rake angle • Point angle etc. 21) Calculate the speeds of various sizes of drills using appropriate formulae. 22) Identify various metal joining operations

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	23) Fabricate metal container by Knock-up joining 24) Join metals by the grooving technique 25) Fabricate metal container by knock-up joining 26) Carry out soft soldering 27) Identify the tools used for wood work 28) Mark out and prepare wood for various operations as described in 7.2 29) Carry out various woodwork operations using the tools in 7.1 -7.3 30) Maintain all tools and machines used 31) Identify the steps and tools involved in making a simple machine part using wood as material 32) Carry out reaming operations: • On the bench • On drilling/lathe 33) Select correct speeds for reaming small and large holes 34) Select correct tapping drill size 35) Select correct taps 36) Carry out tapping operation: • On the work bench • On drilling machine • On lathe 37) Calculate tapping drill sizes 38) Identify various types of plastic groups

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	39) Identify the characteristics of each type of plastic. 40) Use conventional metal cutting tools to perform operations on plastics. 41) Carryout joining operations using plastics
Electrical Drawings EEC 111	1. Identify electrical and electronic symbols 2. Identify different standards of symbols 3. Read and interpret Electrical, Building and Electronic diagrams. 4. Draw Symbolic Electrical circuits 5. Draw Building wiring diagrams showing all components, wiring, conduits, switch boxes, wall plugs. 6. Draw a simple electrical circuit with voltage and current source and other circuit elements. 7. Identify standard symbols 8. Perform Power experiments" from the symbolic diagrams to wiring diagrams showing terminals and earth points and how " 2 channel Oscilloscopes" should be connected without shorting the circuit. 9. Draw a typical electrical installation project using standard symbols. 10. Draw electronic circuits using standard

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	symbols 11. Identify machine diagrams 12. Identify redline drawings 13. Carryout redline drawings marking 14. Use computer software to draw electrical installation diagrams 15. Draw machine diagrams using computer software 16. Draw electronic circuit diagrams using computer software
Introduction to Digital Electronics EEC 112	1. Demonstrate conversion from decimal and hexadecimal 2. Investigate the logical behavior of AND, OR, NOT, NAND, NOR, and EX-OR gates. 3. Show the NAND gate as a Universal Gate 4. Interpret truth tables for logic gates 5. Verify Boolean Laws using the various logic gates 6. Construct the truth table of various logic gates and combination circuits using logic gates. 7. Evaluate various combinational circuits such as adders, subtractors, 8. Design and implement adders and subtractors using logic gates 9. Implement adders and subtractors using logic gates

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	10. Design and implement of 4-bit binary adder/subtractor and BCD adder using digital ICs 11. Implement of 4-bit binary adder/subtractor and BCD adder using digital ICs 12. Interpret truth tables for multiplexers and de-multiplexers 13. Implement multiplexer and demultiplexer using logic gate 14. Design multiplexer and demultiplexer using logic gates and study of IC 74150 and IC 74154 15. Evaluate flip-flops, counters, and shift registers. 16. Implement SISO, SIPO, PISO, and PIPO shift registers using flip-flops. 17. Verify of 4-bit ripple counter and Mod-10, Mod-12, and Mod-N ripple counters 18. Simulate various combinational circuits, sequential circuits flip-flops, and counters. using relevant software 19. Interpret Truth Tables for latches, flip flops, and counters 20. Identify the Microcontrollers. 21. Identify Microcontroller Input/Output ports, power pins, reset and clock pins. 22. Perform Basic Programming.

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	23. Load the program from PC to microcontroller via programmer. 24. Setup the hardware (vero board, breadboard, microcontroller, led, sensors. 25. Interface microcontrollers with sensors
Technical Documentation and Report Writing EEC 113	1. Identify types of technical documentation 2. Operate text editors: • Microsoft Word, • LaTeX. 3. Prepare simple drawings, diagrams using AutoCAD. 4. Conduct simple calculations and prepare graphs using Microsoft Excel. 5. Use collaborative platform: • Google Docs. 6. Prepare project proposal including its specific sections: • Client requirements • Specification • Proposed drawings • Bill of materials • Material and labour cost estimation • Execution period 7. Write a project report based on list of project sections.

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	8. Identify mistakes in technical report and correct them. 9. Identify guidelines for document calculations. 10. Identify guidelines for graphs and numerical data preparation and representation. 11. Fill a Logbook based on work carried out. 12. Write a laboratory experiment report. 13. Write a non-technical report for: • Progress report • New Development • Recommendation 14. Prepare complete RAMS document. 15. Prepare of a comprehensive technical project related to hypothetical or real-world scenarios in Electrical and Electronics Engineering - individual or group projects. 16. Present the projects to the class for 17. Peer and teacher evaluation based on clarity, accuracy, and professionalism.
Electrical Engineering Science I EEC 114	1. Determine the effect of variable EMF on single loop DC circuit. 2. Measure current and voltage of power source in a simple circuit using a multimeter

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	3. Verify Ohm's law. 4. Demonstrate series and parallel circuits. 5. Verify the effect of varying resistance on current flow in a conductor. 6. Verify the Kirchhoff's Laws with DC circuits. 7. Verify superposition principle. 8. Determine the temperature coefficient of a resistance 9. Verify the heating effect. 10. Perform experiment to determine the DC power. 11. Verify Coulombs' Law using experiment. 12. Perform experiment on charging and discharging of a capacitor.
Industrial Health and Safety EEC 115	1. Identify different types of safety signs. 2. Identify workplace hazards in a real or simulated environment. 3. Document workplace hazards in a real or simulated environment. 4. Perform risk assessments and recommend control strategies. 5. Select, use, and maintain correct PPE for specific tasks. 6. Select appropriate signage according to location-specific hazards. 7. Install appropriate signage according to location-specific hazards.

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	8. Apply relevant legislative requirements to assess workplace compliance. 9. Interpret key legislative safety signage and documents. 10. Practice legal reporting procedures for unsafe conditions under OHS law. 11. Identify and record hazards in a work environment. 12. Record hazards in a work environment. 13. Conduct a basic risk assessment and suggest control measures. 14. Apply appropriate hazard control methods using the hierarchy of controls. 15. Report on hazards to supervisors or safety reps. 16. Identify control measures in place and assess their adequacy and effectiveness. 17. Apply the hierarchy of control to select appropriate measures for specific hazards. 18. Identify safety and health requirements. 19. Identify Safety signs and symbols. 20. Demonstrate the use of PPE • Safety boots

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	• Helmets • Goggle • Face Shield • Coverall • Earmuff • Harness • Nose Mask • Hand glove 21. Organize a simulated fire drill. 22. Debrief students post-exercise. 23. Demonstrate safe manual handling or machinery use. 24. Conduct role-play of an incident and reporting. 25. Perform first aid 26. Carry out CPR 27. Identify and use first aid materials and tools. 28. Apply appropriate procedures for treating minor bleeding and wounds. 29. Immobilize limbs in cases of suspected

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	fractures or sprains. 30. Perform abdominal thrusts for choking victims (adults and children).
Electrical Power I EEC 121	1. Organize Industrial visits to observe the layout of Generation, Transmission and Distribution of power systems. 2. Draw the layout of Steam plant, Diesel plant, Gas plant, Solar and wind plant. 3. Draw the layout of generation, transmission and distribution of electrical power systems. 4. Draw the diagram of generating station, transmission and distribution networks with voltage levels. 5. Identify the basic components of distribution systems 6. Determine balancing situations of connected grid to distribution network to ensure power and load demand are equal via calculation 7. Identify the parts a fuse. 8. Demonstrate the function of a fuse. 9. Identify the moulded case circuit breaker. 10. Demonstrate the function of an isolator. 11. Identify the difference between a circuit breaker and an isolator

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	12. Identify types of insulators. 13. Demonstrate the applications of insulators in distribution network
Electrical Machine I EEC 122	1. Determine direction of magnetic field. 2. Disassemble and assemble a DC Generator. 3. Determine a DC Generator terminal. 4. Determine the characteristics of separately excited DC Generator. 5. Perform an experiment to show the relationship between armature voltage and load current 6. Interpret a Motor name plate 7. Conduct an experiment on DC Shunt motor Characteristics. 8. Carry out experiment on DC Series motor Characteristics. 9. Perform an experiment on DC Compound motor Characteristics. 10. Carry out an experiment on starting DC motor using a relay 11. Perform experiment on the Characteristic of Split phase induction motor. 12. Carry out experiment on Characteristic of Capacitor Start motor and Capacitor run motor

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	13. Inspect and maintain a Motor 14. Perform troubleshooting and repair of AC motors
Electronics I EEC 123	1. Construct a simple electronic circuit consisting of two resistors in series as a voltage divider 2. Identify Semiconductor components with their circuit symbol. 3. Carry out an experiment on breadboard to implement circuit from the schematic diagram. 4. Perform experiment on how to solder and unsolder components on a printed wiring circuit board 5. Demonstrate soldering Techniques 6. Conduct an experiment on measurement of direct current in a circuit. 7. Carry out experiment to measure the effect of resistance and observe the effect of voltage in controlling current in a circuit. 8. Perform an experiment to observe and measure input and output waveforms of a full – wave rectifier 9. Carry out experiment to determine the time constant of a Capacitor 10. Perform an experiment to show Zener

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	diode as a Voltage regulator. 11. Carry out experiment to show Static Characteristic of a PNP Transistor in the Common base configuration 12. Test Bipolar Junction Transistor. 13. Test PN Junction diode with Multimeter 14. Perform experiment to determine the Characteristic of thyristors 15. Carry out experiment to show Static Characteristic Thyristors 16. Carry out experiment to investigate thyristor switching
Electrical Engineering Science II EEC 124	1. Determine the B-H curve for magnetic material (Hysteresis curve) 2. Determine the magnetic energy loss in magnetic materials 3. Verify Faraday's law of electromagnetic induction 4. Verify Lenz's law of electromagnetic induction. 5. Determine the inductance of a coil. 6. Determine energy loss in an inductor. 7. Determine the energy loss in an inductor. 8. Determine the equivalent inductance of serial and parallel inductive circuits. 9. Determine the magnetic coupling in a

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	transformer 10. Determine the frequency, period and amplitude of a sinusoidal signal. 11. Determine the series and parallel resonance of an AC circuit. 12. Determine the Quality-factor (Q-factor) of series and parallel RLC circuits.
Electrical and Electronics measurement and Instrumentation EEC125	1. Identify the instruments listed below: • Digital multimeter • Analogue multimeter • Voltage tester • Clamp meter • Oscilloscope • Insulation resistance tester (Megger) • Tachometer • Wattmeter • Thermometer • Frequency Counters • Battery tester 2. Demonstrate ohm's law using variable resistance and variable E.M.F 3. Demonstrate practical examples of error 4. Determine the resistivity of materials 5. Verify Kirchhoff's current and voltage

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	law 6. Demonstrate superposition Theorem 7. Demonstrate the use of the following using different circuits: • Digital multimeter • Analogue multimeter • Voltage tester • Clamp meter • Oscilloscope 8. Measure voltage and current by connecting Multiplier and Shunt respectively. 9. Charge and discharge a capacitor, inductor 10. Calibrate and measure with multimeter. 11. Measure direct current (d.c) voltage in experiments using multimeter 12. Measure alternating current (a.c) voltage in experiments using digital multimeter 13. Calculate the Values of the multiplier and shunt. 14. Calibrate a moving coil instrument 15. Use meters to measure: • Voltage • Current • Variable frequencies

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	• Earth resistance • Insulation resistance • Current (Clamp meter) 16. Sketch a diagram of the following meters: • Digital Voltmeter • Frequency Counter • Ohmmeter • Ammeter • Merger • LCR meter 17. Identify earth point
Telecommunication I EEC 126	1) Visit a communication service provider company 2) Identify the basic segments in the block diagram of the communication system. 3) Visit AM and FM radio stations 4) Demonstrate modulation and demodulation in AM and FM Modes 5) Visit AM and FM Radio stations 6) Demonstrate the operation of receivers using receiver trainer
Electrical Installation of Buildings EEC 127	1) Identify the standard symbols 2) Sketch the standard symbols 3) Interpret a schematic diagram 4) Interpret a wiring diagram

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	5) Conduct earth resistance test to ascertain the earth resistance value 6) Identify electrical symbols 7) Insert electrical symbols for the installation layout in building drawings 8) Produce a single line diagram based on the layout 9) Interpret building drawings. 10) Identify cables and their sizes 11) Select appropriate cables for different uses 12) Draft electrical services for a residential building e.g. 3-bedroom flat 13) Demonstrate installation of various types of joints using PVC flexible cables. 14) Design an electrical service for a 3-bedroom flat. 15) Identify cable colour coding commonly used in Nigeria. 16) Carryout laying of cables using different trunking methods. 17) Apply I.E.E. wiring Regulations related to cables and their uses. 18) Identify types of joints Extract items for bill of quantities from drawings. 19) Conduct market survey (hypothetical) 20) Assess the cost of materials.

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	21) Prepare typical bill of quantity 22) Identify the components of Solar power system. 23) Install Closed-Circuit Television (CCTV). 24) Install a satellite Television with its accessories. 25) Install Electrical service mains for a premises 26) Install a prepaid meter in a premises
Logic and Linear Algebra MTH 202	1) Translate sentences into symbolic form using quantifiers. e.g.: "some freshmen are intelligent can be stated as "for some x,x is a freshman and x is intelligent" can be translated in symbols as (ix) (f x & ix) 2) Give illustrative examples of the fundamental principles of permutations. 3) Establish the formula nPr = $\frac{n!}{(n-r)!}$ 4) Solve problems of permutations with restrictions on some of. the objects 5) Solve problems of permutations in which the objects may be repeated. 6) Solve problems of permutations of N identical objects. 7) State and prove the theorem nCr-1+ $^{n}Cr = {}^{n+1}Cr$

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	8) Illustrative with examples the method of mathematical induction. 9) Identify the binomial theorem for a rational number. 10) Identify the properties of binomial coefficients 11) Apply binomial expansion in approximations (simple examples only). 12) Determine a determine the minors and cofactors 2 by 2 and 3 by 3 matrixes 13) State and prove the theorem "if two rows or two columns of a matrix are interchanged, the sign of the Value of its determinant is changed 14) Identify the minors and cofactors of a determinant 15) Identify the method of evaluating determinants.
Electrical Power II EEC 211	1) Visit a power plant 2) Demonstrate the layout diagrams of power plants 3) Assemble the components of the PV Power generation system for domestic application. 4) Draw a typical load curve 5) Visit a transmission substations 6) Assemble poles, pole supports, and

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	insulators in a dead substation. 7) Connect voltage and current transformers for measurements in the transmission line model. 8) Demonstrate the stages of construction for conductors and laying underground cables: • Two-core cable • Three core cable
Electrical Machine II EEC 212	1) Carryout experiments on circuit characteristics of a 3-phase induction motor. 2) Carryout experiment on circuit characteristics of an alternator/A.C generator. 3) Perform experiment to determine relationship between excitation current and output terminal voltage 4) Perform experiment to determine relationship between speed and output terminal voltage. 5) Demonstrate the construction of electrical machines. 6) Interpret name plate of synchronous and induction motors and generators 7) Demonstrate the conversion of energy in singly excited systems.

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	8) Determine the terminal of a 3 – phase induction motor 9) Determine the terminal of a 3 – phase synchronous generator. 10) Measure the electrical quantities of 3 phase induction motor. 11) Identify the basic difference between motors and generators. 12) Demonstrate the techniques for motor starting and control: • Direct online starter • Star-Delta starter • Soft starter • Variable frequency drive 13) Visit power substation/show video clips 14) Classify transformers 15) Monitor temperature of a transformer. 16) Identify methods of cooling transformers. 17) Sketch phasor diagrams of transformer on load and on No-load 18) Sketch the equivalent circuit of a transformer 19) Perform experiment on open circuit characteristics of a single phase transformer. 20) Perform experiment on open circuit

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	characteristics of three phase transformers. 21) Carryout experiment on close circuit characteristics of a single phase transformer. 22) Perform experiment on close circuit characteristics of three phase transformer. 23) Perform experiment on identifying polarity of a 3-phase transformer. 24) Conduct transformation ration test on a transformer' 25) Use the Open-circuit and Short-circuit tests to determine the equivalent circuit parameters. 26) Sketch possible arrangement of three transformer windings.
Electronics II EEC 213	1) Carry out experiment on FET Static Characteristics in common source configuration 2) Demonstrate the applications of MOSFET: • Switching (DC-DC Converter) • Amplification • Variable resistance (Signal processing) 3) Perform experiment on common source

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	amplifier characteristics. 4) Carry Out experiment on common gate amplifier characteristics 5) Conduct an experiment on common drain amplifier characteristics 6) Perform an experiment on Characteristics of transformer coupled Class A amplifier: 7) Identify the frequency response characteristics of amplifier. 8) Identify the relationship impedance, power and phase relationship.
Electric Circuit Theory I EEC 214	1) Draw to scale phasor diagrams for a.c circuits. 2) Draw phasor diagrams that the current in a capacitor circuit leads voltage and the current in the inductive circuit lags the voltage. 3) Investigate the behaviour of series-parallel connected resistors. 4) Determine the voltage divider. 5) Test the inductor using ohmmeter. 6) Demonstrate how to test capacitor by observing their charging and discharging 7) Convert a.c signal in polar form to the Rectangular form.

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	8) Demonstrate how to verify Ohm‘s law. 9) Simulate resonance conditions in series and parallel RLC circuits. 10) Show with the aid of phasor diagrams that the current in a capacitor circuit leads voltage and the current in the inductive circuit lags the voltage. 11) Show wave forms of lagging and leading angles of voltage and current on a Cartesian plane. 12) Demonstrate the application of mesh circuit analysis. 13) Demonstrate the application of Nodal circuit analysis. 14) Reduce a complex network to its series or parallel equivalent. 15) Derive the formula for the transformation of a delta to a star network and vice versa. 16) Measure the total resistance of combinations of parallel connected resistors. 17) Determine by experiment the total resistance of resistors connected in series. 18) Identify star and delta networks 19) Verify Thevenin’s theorem. 20) Demonstrate the application of Nodal

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	circuit analysis. 21) Verify the Millman's theorem 22) Use Thevenin's theorem to analyze energy delivery from a battery to a load. 9)
Use of Electrical and Electronics Instruments EEC 215	1) Draw the block diagram of an Oscilloscope 2) Measure D.C voltage in experiments using OSCILLOSCOPE 3) Measure A.C voltage in experiments using OSCILLOSCOPE 4) Measure range of frequencies with OSCILLOSCOPE 5) Measure phase angles with OSCILLOSCOPE 6) Sketch Power meter 7) Measure DC and AC power 8) Measure DC and AC power for single and three phase circuits 9) Measure power factor 10) Determine temperature effect on resistance 11) Verify temperature effect on semiconductor diode 12) Measure temperature range using digital thermometer 13) Design a simple controller circuit

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Telecommunication II EEC 216	1) Demonstrate amplitude modulation with signals in audio frequency band. 2) Demonstrate amplitude demodulation with AM modulated signal. 3) Determine the frequency deviation with FM modulated signal. 4) Demonstrate the frequency demodulation with FM modulated signals. 5) Determine how radio receivers operate 6) Visit a television station 7) Use appropriate software to simulate the wave propagation of antenna 8) Set up a simple cable network 9) Configure a router 10) Connect two routers or access points 11) Transfer information using: • Wireless fidelity (WI-FI) • Bluetooth • Intranet
Computer Hardware and Software I EEC 217	1) Identify computer components 2) Dismantle a computer system and show the: • RAM card • Hard Disk

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	• Processors. 3) Identify: • Input mechanisms 4) Output Mechanisms Assemble computer sub-units. 5) Identify the memory, ports, CPU and power supply unit 6) Identify the computer CMOS battery for memory retention. 7) Identify the various types of port: • Parallel • Serial • USB 8) Identify the components of a computer hardware: • Input/output System Unit • Processing unit • Storage devices 9) Demonstrate how to start and shut down a computer system. 10) Identify different types of cables and connectors. 11) Demonstrate how to connect Computer Ports to peripherals. 12) Demonstrate how you can setup and connect a printer to a computer.

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	13) Setup some printing exercise 14) Identify a modem and draw a block diagram of a modem 15) Draw a block diagram showing the interconnection of the Sub-units of the motherboard. 16) Identify computer components 17) Dismantle a computer system and show the: • RAM card • Hard Disk • Processors. 18) Identify: • Input mechanisms • Output Mechanisms 19) Access computers correctly through Windows operating system such as: • Open/Close a window • Program Manager • Button bars/scroll bars/ menu bars • Moving from one Window to another 20) Create a file and folder 21) Manipulate files (moving, copying, saving, deleting). 22) Manipulate Print Manager. 23) Demonstrate the competent use of a

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	word-processing package such as: • MSWord (or equivalent standard). • Entering text • Formatting text (emboldening, font size, italicizing). • Creating and Saving text files • Editing and moving text • Importing objects • Spelling and Grammar Checking. • Create tables, text boxes, equations. • Type a short document and save it. • Edit a document and carryout a spelling check. • Demonstrate the use of tables. • Use the Internet to retrieve information. • World Wide Web(WWW) • Download information • Paste retrieved information into an appropriate application • Use-mail to send and receive messages. • National and international e-mail • E-mail attachments (sending& receiving) 23)

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Research Methods in Electrical and Electronics Engineering Technology EEC 218	1) Identify sampling techniques 2) Use the selected technique to a draw sample 3) Identify types of data 4) Identify sources of data 5) Use data collection techniques to conduct research 6) Use statistical tools to present data 7) Write research report
Electrical Power III EEC 221	1. Determine the sending and receiving end voltage of the transmission line. 2. Determine the voltage regulation and transmission efficiency. 3. Conduct a load flow study of two bus power network using appropriate software 4. Run a programme for a load flow analysis of a two-bus power network. 5. Construct the power circle diagram. 6. Formulate the nodal admittance matrices for a two-bus network. 7. Calculate the load flow in an interconnected system 8. Classify the variables in 1.9 into control dependent and independent 9. Identify the faults on generators, transformers and T-line. 10. Insert an open circuit and earth faults

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	on transmission lines using appropriate software 11. Determine the fault levels on typical power systems. 12. Determine the MVA fault level on typical power systems. 13. Draw typical waveforms of short circuit currents in power systems. 14. Plot graphs for voltage and current surges when R is less than Z_o ($R < Z_o$) 15. Test Insulators to determine their voltage distribution and string efficiency. 16. Draw a typical surge waveform. 17. Identify lightning arrester 18. Classify relays
Computer Hardware and Software II EEC 221	1. Demonstrate how to carry out computer maintenance 2. Repair common power supply issues. 3. Upgrade laptop components (RAM, SSDs, Wi-Fi cards). 4. Disassemble and repair a faulty motherboard. 5. Upgrade components in a laptop or desktop to improve performance.

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	6. Identify computer hardware components 7. Identify AT and ATX f power packs 8. Identify different computer interface cables 9. Assemble a Computer System. 10. Disassemble a Computer System. 11. Identify faults in the following: • Power supplies • System clocks • Memory Cards • Low battery • I/O ports, • Disk drives • Voltages • Keyboard • Monitors • Scratches on discs 12. Rectify the following faults: • Overheating • Slow performance • Blue screen of Death • Internet connectivity issues • Malware

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	• Frozen screen • Power issues • Software crashes • Peripheral device issues • Ram (memory) issues • Unable to boot • Applications won't install • CPU problems • Data loss issues • Dropped internet connections 13. Demonstrate indentation and comments in python 14. Demonstrate different types of python data 15. Demonstrate functions associated with numpy 16. Demonstrate the use of numpy library 17. Create table and classes 18. Manipulate the usual functions associated with numpy in python 19. Demonstrate the pandas library

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	20. Demonstrate how to build and manipulate a data frame 21. Identify the main algorithm of python 22. Demonstrate the launch of MATLAB 23. Demonstrate MATLAB window as a calculator 24. Demonstrate the following in MATLAB windows library 25. Demonstrate the following data in MATLAB window • Integer (int) • Float • String • Boolean Simulate an RLC circuit using MATLAB
Electronics III EEC 223	1. Investigate the effect of applying negative feedback on a distorted signal, input, output and impedances of negative feedback on an amplifier. 2. Design a controller with simple control system configuration 3. Measure the frequency and amplitude of a sinusoidal signal of an LC-Colpitts

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	oscillator. 4. Measure the frequency and amplitude of an output generated signal. 5. Carryout experiment to investigate the factors which affect the operation of LC Hartley oscillator and measure the frequency and amplitude of a generated signal 6. Carryout an experiment to determine the factors which influence the operation of transistorized monostable, bistable and astable multivibrators. 7. Carryout an experiment to determine both the input and output waveforms of a bridge rectifier and the effects of different filter circuits 8. Build a circuit consisting of 555 multivibrator to determine 50% duty cycle square wave output signal 9. Sketch a block diagram representation of a converter with its components 10. Measure the input and output current and voltage levels of a converter and determine the frequency waveforms
Electric Circuit Theory II EEC 224	1. Demonstrate the effect of the step-down transformer. 2. Carryout Continuity Test on a Single Phase Transformer.

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	3. Carryout experiment on the turns ratio of a transformer 4. Measurement of voltage and current. 5. Carryout continuity test in three phase transformer. 6. Demonstrate terminals of three phase transformer. 7. Demonstrate Three phase star connected circuits. 8. Demonstrate three phase delta connected circuits. 9. Sketch the growth and decay curves in RC circuits. 10. Sketch curves for growth and decay of current and voltage in RL circuits. 11. Demonstrate three phase power measurement using two wattmeter method. 12. Demonstrate starting method of three-phase induction motors, Direct on-line starting method. 13. Measure the electrical quantities of 3-phase induction motor. 14. Determine three -phase Induction motor under load. 15. Determine Torque – Current Characteristic 16. Connect the 3-phase dual speed squirrel

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	cage induction motor'. 17. Carryout experiment on Induction motor 18. Determine the polarity of coupled coils. 19. Find equivalent circuits for magnetically coupled coils.
Introduction to Industrial Automation EEC 225	1. Identify: • Home Automation • Industrial Automation 2. Identify the elements of the following: • Home Automation • Industrial Automation 3. Identify the parts of a programmable logic controller 4. Identify the types of Input/output devices 5. Identify expansion modules and boards 6. Connect and program different types of sensors and actuators. 7. Connect different analog signals.

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	8. Connect the following to the PLC: • On/Off sensors • Analog sensors • Switches • Actuators • Valves • Drives 9. Turn on a motor or lamp using two buttons applying latching logic 10. Turn off a motor or lamp using two buttons applying latching logic 11. Make a program in ladder diagram 12. Translate a ladder diagram program into electrical and logic circuits equivalent. 13. Carry out basic Timer operations 14. Carry out basic counter operations 15. Download programs to/from a CPU using PLC software 16. Upload programs to/from a CPU using PLC software 17. Interpret what each status light on a PLC or CPU module indicates. 18. Interpret PLC error codes. 19. Resolve common hardware and software issues.

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	20. Identify components of robot based on configuration and application. 21. Identify household items that can be characterized as mechatronic System. 22. Identify components of the task above that help identify them as mechatronic Systems. 23. Identify the characteristics of the following: • LVDT • Variable Capacitor. • Light Dependent Resistor • Resistance Temperature Detector • Thermistor. • Thermocouple. 24. Identify different drives 25. Program a basic HMI for a PLC system.

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List of Minimum Resources

LISTS OF EQUIPMENT, INSTRUMENTS AND TOOLS IN THE LABORATORIES, WORKSHOPS AND STUDIOS FOR ND ELECTRICAL & ELECTRONICS ENGINEERING TECHNOLOGY

A. BASIC ELECTRICITY, MEASUREMENT AND INSTRUMENTATION LABORATORY

S/N	DESCRIPTION OF ITEM	QUANTITY
1.	Basic Electricity Kit/Trainer	5
2.	Electronics Trainer	3
3.	Experimental Trainer for AC and DC	3
4.	Analogue Multimeter	5
5.	Digital Multimeter	5
6.	Wheatstone Bridge	5
7.	Potentiometer	5
8.	Rheostats (Various ranges)	10
9.	Wattmeter	5
10.	Variac	5
11.	Ammeters (Various ranges) 0- 25A DC 0- 2 A AC	 5 5
12.	Milliammeter 0 1000mA DC 0- 1000mA AC	 5 5
13.	Micrometer 0- 1000mA DC 10- 1000mA AC	 5 5
14.	Voltmeter 0- 500V DC 0- 500V AC	 5 5
15.	Millivoltmeter 0- 1000mV DC	 5

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16.	Ohmmeter 0- 5 ohms 0- 25 ohms 0- 50 ohms (Multirange)	 5 5 5
17.	Galvanometer (triple range) 50-0-50mA 500-0-500mA 5-0-5 mA	 5 5 5
18.	Fire extinguisher	1
19.	First aid box	1
20.	Safety bucket	1
21.	Safety posters	6

B. ELECTRONICS/TECOMMUNICATIONS LABORATORY

S/N	DESCRIPTION OF ITEM	QUANTITY
1.	Semiconductor Kit/Trainer	5
2.	Digital Trainer/Logic Tutor	5
3.	Operational Amplifier (Op-Amp)	5
4.	Arduino Uno kits	5
5.	Function Generator	5
6.	Frequency Counter	5
7.	Electronics Trainer	5
8.	Communication Trainer Kit	5
9.	AM/FM Transmitter and Receiver	5
10.	Transistor Amplifier Trainer/Demonstrator	5
11.	Circuit Construction Deck/Trainer	10
12.	Microcontroller	5
13.	Microcontroller Trainer	5

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14.	Function Generator	5
15.	Frequency Counter	5
16.	Digital Oscilloscope: i. 50MHz ii. 100MHz	 5 5
17.	Signal generators (AF, RF)	5
18.	I.C. Tester	5
19.	Transistor Tester	5
20.	DC Power Supply Out-put 0 – 20V/0-2A	5
21.	Power Supply Unit 0-60V/3A units	5
22.	Amplifiers	5
23.	Multivibrator	5
24.	Sweep generator	5
25.	Digital Multimeter	10
26.	RLC bridge	5
27.	Optocoupler	5
28.	Oscillator	5
29.	Wave guides	5
30.	Fire extinguisher	1
31.	First aid box	1
32.	Safety bucket	1
33.	Safety posters	6

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C. POWER & MACHINES LABORATORY

ELECTRICAL POWER SECTION		
S/N	**DESCRIPTION OF ITEM**	**NUMBER REQUIRED**
1.	Power Demonstration Units	3
2.	Stabilizer power units	3
3.	Power factor meter	5
4.	Wattmeter: - Single - 3 Phase	 5 5
5.	Energy meter: - Single - 3 Phase	 5 5
6.	Digital Multimeter	5
7.	Analogue Multimer	5
8.	Clip-on ammeter	5
9.	Transmission and Distribution Lines Model	3
10.	Insulation Resistance Meter (Megger testers)	3
11.	Tachometer (mechanical)	5
12.	Stroboscope	5
13.	Digital phase meter	5
14.	Phase sequence meter/indicator	5
MACHINES SECTION		
S/N	**DESCRIPTION OF ITEM**	**NUMBER REQUIRED**
15.	Motor-Generator Sets for Laboratory Use (DC supply source)	1
16.	Machine Control Panel Trainer	1
17.	Tachogenerator	5
18.	Synchronous Motor	5

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19.	DC motors: - Series - Shunt - Compound	 3 3 3
20.	DC Generators: - Self excited - Separately excited - Shunt - Compound - Starters	 3 3 3 3 3
21.	A. C. Motors: - Single phase induction motors (assorted) - 3 phase induction motor - Dynamometer set - Direct online starters - Star-delta starters	 3 3 3 3 3
22.	Transformers: - Power Transformer (single phase) - Power Transformer (3-phase) -Transformer Trainer (Single Phase) -Transformer Trainer (Three Phase)	 5 5 2 2
23.	Variable resistance load	3
24.	Variable inductive load	3
25.	Variable capacitive load	3
26.	Single Phase Capacitor Start Capacitor Run Motor”	5
27.	Compound motor relay	5
28.	Flux Meter	5
29.	PID Controller	5

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30.	Plotter	2
31.	Temperature Sensors	3
32.	Thermometer	5
33.	PLC device with training board equipped with manual switches for digital inputs and adjuster voltage/current source for analog inputs, sensors, audio switches and actuator for training	3
34.	PLC programming software	5
35.	SCADA software	2
36.	Samples of motor name plate	10
37.	Fire extinguisher	1
38.	First aid box	1
39.	Safety bucket	1
40.	Safety posters	6

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LISTS OF EQUIPMENT, INSTRUMENTS AND TOOLS IN THE WORKSHOPS

D. ELECTRICAL INSTALLATION AND MAINTENANCE WORKSHOP

S/N	DESCRIPTION OF ITEM	QUANTITY
1.	Wiring boards (0.7m x 0.7m)	40
2.	Pedestal drill	1
3.	Hand drill	3
4.	Electrician tool kits	10
5.	Conduit bending machine, and accessories (for Metal)	3
6.	Conduit Bending (Spring Type – for PVC)	20
7.	Bench vices	5
8.	Earth leakage circuit breakers (ELCB)	6
9.	Cable jointing kits for: - Soldering pot & ladle - Soldering iron - Modern Raychem joints - Blowlamp	 2 40 3 3
10.	Earth rods and accessories	5
11.	Simulated wall for vertical conduit and metal cable installations	3
12.	Various sizes of PVC cables	5
13.	MICC cables and accessories	5
14.	Underground cables and accessories	5
15.	Various consumables (lamp holders, sockets, etc)	Lot
16.	Insulation Resistance Meter (Megger Tester)	5
17.	Overhead line materials: - Safety belts - Conductor joint kits - Earthing kits	 10 5 3

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18.	PV Panels	4
19.	Inverter	2
20.	Charge Controller	2
21.	Electric cookers, fans, iron etc. (used ones)	3 each
22.	Motors (assorted) used ones	3
23.	Generators (assorted) used	3
24.	Starter: - Direct online - Star delta -Auto Transformer	 3 3 2
25.	Coil winding equipment (Manual)	1
26.	Coil Winding Equipment (Electric/Auto)	1
27.	Refrigerator (used)	2
28.	Satellite Dish	2
29.	Satellite Decoder	2
30.	Battery charging facilities - Charger (trickle, constant current and constant voltage charging system) - Battery - Electrolytes - Hydrometer	 1 1 3 3
31.	Thermo-setting and thermo-plastic	3
32.	Multimeter	5
33.	Earth-loop tester	3
34.	Fire extinguisher	1
35.	First aid box	1
36.	Safety bucket	1
37.	Safety posters	6

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E. ELECTRONIC WORKSHOP

S/N	DESCRIPTION OF ITEM	QUANTITY
1.	Electronic technician tool kits	10
2.	Electronic Discrete Components: (Resistor, Capacitors, Inductors, diode, Zener diodes, Transistor (BJT, FET, JFET, MOSFET), Thyristor, SCR, Multivibrator, etc.)	Assorted
3.	Soldering Station	5
4.	Soldering iron (assorted)	20
5.	Multimeter	10
6.	I.C. Tester	5
7.	Transistor tester	5
8.	Galvanometer	5
9.	Radio Set (used one)	5
10.	TV Sets (Plasma, LED) – used one	5
11.	Amplifiers	5
12.	Oscilloscope	1
13.	DC Power Supply	3
14.	Phone (Keyboard) (used)	5
15.	Android phone (used)	5
16.	Phones Repair Kits	5
17.	Microphones	3
18.	Transceivers (walkie talkie)	5
19.	DC/DVD Player	5
20.	Bread Board	30
21.	Vero Board	30
22.	Fire extinguisher	1
23.	First aid box	1
24.	Safety bucket	1
25.	Safety posters	6

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F. MECHANICAL WORKSHOP

S/N	DESCRIPTION OF ITEM	QUANTITY
1.	Pillar drilling machine	3
2.	Bench drill machine	3
3.	Hand drill machine	6
4.	Drilling Machine Accessories	1
	(i) drill sets in boxes	4
	(ii) drills 1/16"x 1/2"	4
	(iii) drills 1mm	4
	(iv) Drill chuck and keys	4
5.	Shaping Machine	1
6.	Grinding Machine	2
7.	Gabro type guillotine/Notches 2M	1
8.	Lathe Machine	1
9.	Riveting machine	1
10.	Power hacksaw (metal cutting machine) with accessories	1 unit
11.	Saw	Assorted
12.	Welding/Fabrication Equipment	
	i. Electric Unit with accessories	2
	ii. Gas Unit with accessories	2
	a. Welding beds	2
	b. Brazing equipment	2
	c. Brazing rods	2
	d. Soldering rods	2
13.	Safety goggles	10
14.	Apron (leather)	10
15.	Anvil	2

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16.	Welding Booth	3
17.	Welding Marking out tools	Assorted
18.	Welding head shield	4
19.	Welding joint teaching aids (diagram)	Assorted
20.	Pliers	Assorted
21.	Punches	Assorted
22.	Screw Driver	Assorted
23.	Spanners	Assorted
24.	Files	Assorted
25.	Boring tools	Assorted
26.	Micrometers Manual	4
27.	Micrometers Digital	4
28.	Rules	Assorted
29.	Vernier Calipers	Assorted
30.	Gauges	Assorted
31.	Hammers	Assorted
32.	Mallets	Assorted
33.	Stock and dies	1 set
34.	Hand Machine Reamers	1
35.	Clamps	Assorted
36.	Tap and Wrenches	2
37.	Chisels	Assorted
38.	Scrapers	Assorted
39.	Fire extinguisher	1
40.	First aid box	1
41.	Safety bucket	1
42.	Safety posters	6

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LISTS OF EQUIPMENT, INSTRUMENTS AND TOOLS IN THE STUDIOS

G. DRAWING STUDIO

S/N	DESCRIPTION OF ITEM	QUANTITY
1.	Drawing tables	40
2.	Drawing/drafting stools	40
3.	Adjustable set squares	4
4.	Desk sharpeners	4
5.	Scale rule (triangular and flat)	30
6.	White board rulers	4
7.	White board Tee-squares	4
8.	White board set-squares (45 & 60)	4
9.	White board compasses	4
10.	White board protractor	4
11.	French curve	4
12.	Letter and number stencils	10
13.	Storage cabinet for drawing papers	1

H. COMPUTER STUDIO/SOFTWARE LABORATORY

S/N	DESCRIPTION OF ITEMS	QUANTITY
1.	Computer systems	30
2.	Solar Power Installation	1
3.	Internet Connectivity	1
4.	Printer (All-in-one)	1
5.	Multimedia Projector	1
6.	Projector screen	1
7.	Software packages - Operating system (Windows, Linux, Macintosh etc)	1 each

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	- Network operating systems - Simulation software (Multisim, Proteus Design, MATLAB, Python, Electronic workbench, Packet Tracer, Scilab, Octave etc) - PLC and SCADA Software - Application suites (MS Office suite etc) - Integrated Development Environment (MS Visual studio, NetBeans etc) - Word processing - Spreadsheet - Statistical packages - Graphics packages - Educational packages	
8.	Troubleshoot software packages	Varieties
9.	Fire extinguisher	1
10.	First aid box	1
11.	Safety bucket	1
12.	Safety posters	6

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LIST OF PARTICIPANTS 2022 REVIEW WORKSHOP

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