BACHELOR OF SCIENCE ELECTRICAL/ELECTRONICS ENGINEERING

PROGRAMME

SEPTEMBER 2023

THE GAMBIA UNIVERSITY OF APPLIED SCIENCE, ENGINEERING AND TECHNOLOGY

THE GAMBIA UNIVERSITY OF SCIENCE, ENGINEERING AND TECHNOLOGY (USET)

College of Science and Engineering
Department of Electrical/Electronics Engineering

Curriculum For:
Bachelor of Science in Electrical/Electronics Engineering

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Bachelor of Science – Electrical/Electronics Engineering Programme

1.0 Name of institution - State the name of the institution that developed and/or will deploy the curriculum.

The Gambia University of Applied Science, Engineering and Technology (USET)

2.0 Process of curriculum development – Describe the process used and stakeholders involved in developing the curriculum (provide evidence wherever necessary).

The stages of curriculum development are categorized into six as follows: (1) needs assessment, (2) the formulation of objectives and outcomes, (3) the development of the programme structure, (4) development and organization of content, (5) delivery and revisions based on stakeholder input, and (6) final curriculum.

2.1 Needs Assessment

Through the National Development Plan (2018-2021), The Gambia government intends to continue to invest in its citizens, as it seeks to transition to a more prosperous society and a competitive economy. In its drive to provide quality and relevant tertiary and higher education in The Gambia, the Ministry of Higher Education, Research, Science and Technology has embarked on a reform programme that is transforming the post-secondary education system, more so, the public tertiary and higher education institutions. To this end, a policy target of 65 percent has been allotted to STEM-related training and development. It is envisaged that graduates in STEM and related science areas will be responsive to the development needs of the country and the sub-region. The Gambia is harnessing the gains of the ACE I project, and the opportunities accorded by the World Bank in the ACE Impact to establish an Emerging Centre of Excellence on Science, Technology and Engineering for Entrepreneurship at the Gambia Technical Training Institute (GTTI). This Emerging Centre will deliver degree programmes and would serve as the first phase of the GTTI transformation into the University of Science and Technology (USET). The approval for the establishment of the USET was obtained in December 2020 through the provisions of Tertiary and Higher Education Act, 2016. Access to tertiary and higher education in the Gambia has been a challenge due to the limited number of technical institutions. For instance, access to programmes beyond level 4 International Standard Classification of Education (ISCED) is limited. Higher education institutions (Universities), constitute only 5.5%; tertiary institutions represent 7.3% and post-secondary non-tertiary education constitutes 87.2% (MoHERST Database 2020). It is obvious therefore that the capacity to absorb transiting and out of school students is limited and needs urgent redress. The Bachelor of Science in Electrical/Electronic Engineering responds to the need for Science, Technology, Engineering and Mathematics (STEM) education at the post-secondary level.

2.2 Formulation of Objectives and Outcomes

The mission of the University as directed by the Ministry of Higher Education and the requirement of The World Bank drive the Objectives and the Outcomes of the Curriculum. The Government of the Gambia desires the University to develop human resources in Science, Technology, Engineering and Mathematics (STEM) with the entrepreneurial skills. The donor agency (The World Bank) desires to have a curriculum that can be benchmarked against other international programmes via an international accreditation agency. The programme educational objectives (Section 7.1) and the Student Learning Outcomes (Section 7.2) were developed and shared with the ACE Programme Steering Committee as well as the industry stakeholders. Mapping of the two desired outcomes is presented in Section 7.3 below.

2.3 Development the Programme Structure

The standard used is based on the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology (ABET). ABET has set the standard for programmes in applied and natural sciences, computing, engineering and engineering technology. ABET provides specialized

accreditation for post-secondary programs within degree-granting institutions already recognized by national or regional institutional accreditation agencies or national education authorities worldwide. To date ABET has accredited programmes in over 40 countries in all regions of the world. The programme structure based on ABET standards is presented in Section 9 below.

2.4 Development and Organization of Content

The organization and content were driven by three sources. These are: (1) The United States National Council of Examiner for Engineering and Surveying (NCEES), (2) Similar Programmes in the United States (*Michigan State University and North Carlina State University*), in Ghana (*Kwame Nkrumah University of Science and Technology*), in Nigeria (*Ahmadu Bello University*), and (3) Specialization based on local needs.

2.5 Delivery and Revisions

The programme was distributed to stakeholders in The Gambia and to Kwame Nkrumah University of Science and Technology, our ACE Mentoring Institution. A draft of the content of the curriculum was shared with Professor Rahman, the Dean of Faculty of Electrical and Computer Engineering (anoprof1@yahoo.com) and Frimpong, Head of Electrical Engineering (frimponge@yahoo.com) for review and feedback. A roundtable discussion was also held with Electrical Engineering lecturers who were visiting USET during their assignments in The Gambia. Their input and recommendations were considered in the development of the document. Additionally, a second-tier of roundtable discussion was held at the local level through MoHERST on October 27, 2022. Representatives of the following were in attendance: Ministry of Higher Education, Research, Science and Technology (MoHERST), Gambia Cellular (GAMCEL), Gambia Ports Authority (GPA), Gambia International Airlines (GIA), University of Applied Science, Engineering and Technology (USET), and National Accreditation & Quality Assurance Authority (NAQAA). The attendees were provided with the draft document. The recommendations arising out of the discussions were considered in the development of the drat final curriculum which was discussed with the Management Team of USET on November 1, 2022.

3.0 Programme Title/Course of Study – State the name or title of the programme which will reflect the award the students will receive.

Electrical/Electronic Engineering

4.0 Level of the programme – Give the level of the award

Bachelor of Science

5.0 Programme description – State a brief description of what the programme is about and the target group.

Electrical engineers design, develop, test, and supervise the manufacture of electrical equipment, such as electric motors, radar and navigation systems, communications systems, and power generation equipment. Electrical engineers also design the electrical systems of vehicles such as automobiles, and aircrafts. Electronics engineers design and develop electronic equipment, including broadcast and communications systems, such as Global Positioning System (GPS) devices. Many also work in areas closely related to computer hardware. The Electrical and Electronics Engineering Programme seeks to develop the student's ability to design new ways to use electrical power to develop or improve products, perform detailed and sound analysis, support manufacturing, construction, and installation standards and specifications, installation and testing of electrical equipment to ensure that products meet specifications, codes and standards. The Bachelor of Science in Electrical and Electronics Engineering programme has been initiated to provide Gambian citizens with the intellectual capacity and skills needed to contribute to the development of the Nation. The programme is designed for the youth seeking engineering careers to improve existing technologies and to create technologies of the future.

6.0 Admission requirements – State the minimum entry requirements for admission.

6.1 Regular Entry Requirements

The programme has three entry points with different minimum entry requirements as follows:

1. *For WASSCE Applicants*: Credit Passes in English Language, Mathematics, and Physics, AND Credit Passes in **ANY Three (3)** of the following subjects: Further Mathematics, General Science, Chemistry, Biology, Agricultural Science, Technical Drawing, Auto-mechanics, Applied Electricity or any other Science or Mathematics-related courses.
2. *For "A" LEVEL Applicants:* Credit Passes in at least Four (4) Subjects at "O" Level including English Language, Mathematics, and Physics PLUS "A-Level" Credit Pass in **ANY Two (2)** of the following: Physics, Chemistry or Mathematics.
3. *For Mature Applicants:* (1) Must be at least twenty-five years old at the time of submitting the application with a minimum of three years relevant working experience and Credit Passes in English, Mathematics and General Science or Physics in the WASSCE/SSSCE, OR (2) possess a related HND with Credit Passes in English and Mathematics, OR (3) Bachelor's Degree from a recognized institution.

6.2 Transfer Student Requirements

It is anticipated that students may wish to transfer to USET from other local and regional institutions. A student may transfer into the Electrical Engineering Programme from only an accredited College or University and must meet the following requirements:

1. The student must have completed at least two-semesters of the respective curriculum.
2. The student must have passed Calculus I with a grade of "C" or better.
3. The student must have passed College Physics with a grade of "C" or better.
4. The student must have a cumulative Grade Point Average (GPA) of 2.0/4.0 or 2.5/5.0 (equivalent to C) or higher.

Notes:

1. The student will be awarded credits for courses that are relevant to the Programme.
2. The University does not accept transfer credits grades for Pass/Fail courses.
3. No course is accepted for transfer in which a grade below "C" was earned.
4. The maximum transferable credits is 25% of the number of credits required for the programme.

7.0 General objectives of the programme – State the objectives that the entire programme intends to achieve

7.1 Programme Educational Objectives (PEO)

The Programme Educational Objectives have been developed to be consistent with the mission of the institution and the needs of the program's various constituencies in The Gambia. The programme objectives will be reviewed every 5 years to ensure they remain relevant to the needs of the program's constituents. The following objectives must be achieved **within five years after graduation** from the Electrical/Electronic Engineering Programme:

(1) Demonstrate competence in the application of knowledge, technical and entrepreneurial skills as a trained electrical engineer.
(2) Exhibit leadership capabilities in the engineering profession.
(3) Identify contributions made in the development of sustainable infrastructure and technical services in The Gambia and the Sub-Saharan Region.

7.2 Student Learning Outcomes (SLO)

7.2.1 International Benchmark Outcomes: The quality of the USET Engineering programmes will be bench-marked against international requirements with the intent of seeking international accreditation in the future. One of the prime international agencies considered is the Engineering Accreditation

Commission of Accreditation Board for Engineering and Technology (EAC-ABET) based in the United States **(www.abet.org)**. The following student learning outcomes are adopted and modified from ABET Criteria for Accrediting Engineering Programs.

Additionally, in preparation for professional practice, the international standards indicate that the curriculum must include engineering topics necessary to analyse and design complex electrical and electronic devices, software, and systems containing hardware and software components.

Considering the mandate of USET and the desire for international accreditation, the student learning outcomes of the BSc Electrical/Electronic Engineering Programme are as follows. Students must be able to demonstrate:

1. An ability to identify, formulate, and solve complex electrical engineering problems by applying principles of engineering, science, and mathematics.
2. An ability to apply electrical engineering design processes to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
3. An ability to communicate effectively with a range of audiences.
4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments.
5. An ability to function effectively in a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
6. An ability to develop and conduct appropriate engineering experiment, analyse, and interpret data, and use engineering judgment to draw conclusions.
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.
8. An ability to analyse and design complex electrical and electronic devices.
9. An ability to analyse and design systems containing hardware and software components.
10. An ability to apply innovation and entrepreneurial concepts to develop marketable products with accompanying business plans.

***7.2.2 National Accreditation and Quality Assurance Authority (NAQAA) Outcomes*:** The Gambia National Accreditation and Quality Assurance Authority (NAQAA) has listed the required outcomes of tertiary education programmes. In accordance with the requirements, on completion of the programme, the student should be able to:

1. Develop Knowledge and understanding: Understand advanced educational resources which may lead to further academic learning and research solutions to abstract problems.
2. Apply Knowledge and Understanding: Demonstrate operational capacity and management skills using creativity
3. Have Communication skills: Interact with others to convey abstract and concrete solutions to problems in a field of work or study.
4. Have Judgmental skills: Formulate practical and theoretical responses to abstract and concrete problems and make judgements on social and ethical issues.
5. Have Learning skills: Evaluate own learning and can improve key competencies for further learning and promote team training.
6. Develop Autonomy and responsibility: Be responsible for the effective and efficient management of projects and people within agreed timeframes.

7.3 Mapping of International and Local Outcomes

It is worthy to note that the desired international (ABET) outcomes and local (NAQAA) outcomes are related. Table 1 shows the mapping of these two outcomes.

Table 1: Mapping of Outcomes

No	International (ABET)	Local (NAQAA)					
		Acquire Knowledge and understanding	Apply Knowledge and understanding	Communication skills	Judgmental skills	Learning skills	Autonomy and responsibility
1	Identify, formulate, and solve complex engineering problems	✓	✓				
2	Apply engineering design to produce solutions		✓		✓		✓
3	Communicate effectively			✓		✓	
4	Recognize ethical and professional responsibilities		✓		✓		
5	Function effectively in a team					✓	✓
6	Develop and conduct appropriate engineering experiment	✓	✓	✓	✓		✓
7	Acquire and apply new knowledge		✓			✓	
8	Analyse and design complex electrical and electronic devices.		✓	✓	✓		✓
9	Analyse and design systems containing hardware and software components.		✓			✓	
10	Apply innovation and entrepreneurial concepts		✓		✓		

8.0 Total qualification time of the programme (programme duration) – Give the total duration/total qualification time of the programme

Duration is 4 years consisting of 8 semesters. Each semester consists of 16 weeks.

9.0 Components/structure of the programme

9.1 Core courses and electives – List the core courses and electives to be covered indicating the required number of credit hours for each course. The objectives and learning outcomes of each course should be stated. Courses should be stated per term/semester.

9.1.1 Programme Categories: To be eligible for the award of the B.Sc. (Electrical Engineering) degree at USET, a candidate must satisfactorily complete the minimum number of credit units prescribed for the degree. The candidate must satisfy (1) the University General Education Requirements, (2) Basic Science and Mathematics Requirements, (3) Engineering Topics and Practice Requirements, (4) Innovation and Entrepreneurship Requirements, and (5) Internship Requirements. Table 2 provides the list of categories and the credit hours required.

Table 2. Electrical/Electronic Engineering Programme Categories

Item	Category	Accreditation Minimum Credit Hours Requirements	USET Programme Credit Hours
1	General Education	Required: Not Specified	14
2	Mathematics and Basic Sciences	30	30
3	Engineering Topics	45	76
4	Entrepreneurship Requirements	None Specified	16
5	Internship	None Specified	Required - No Credit.
Total		120	136*

**The additional credit hours are due to the entrepreneurship and innovation requirements.*

9.1.2 Numbering System for Courses: Presented below are the courses that shall be offered in the Department of Electrical/Electronic Engineering. The courses are coded with the letters as prefix representing the programme or subject area followed by a three-digit code which indicates the level of the course, type of course (theory or practical) and the semester in which the course is being offered. Shown below is a guide for the identification of the courses.

Course Prefix: English (ENGL), Mathematics (MATH), Chemistry (CHEM), Physics (PHYS), General Engineering Requirement (ENGR), Civil Engineering (CIEN), Electrical/Electronic Engineering (ELEN), and Mechanical Engineering (MEEN). The Three-Digit Code is hereby presented:

First Digit: Year 1 Course (1), Year 2 Course (2), Year 3 Course (3), Year 4 Course (4)
Second Digit: Lecture Only (0), Laboratory Only (1), and Lecture Plus Laboratory (2). Project courses are provided by (9).
Third Digit: Course number ending in an odd number is offered in Semester One (1). Course number ending in an even number is offered in Semester Two (2).

9.2 Outline Of The Programme Curriculum

9.2.1 General Education Courses: These courses are required for each engineering degree-seeking candidate of USET. They collectively provide communication skills and socio-economic knowledge to the student and to improve the student's soft skills. Table 3 provides the list of the general courses.

Table 3. General Education Courses

No	Course Code	Course Title	Credit Hours
1	ENGL 101	English Communication	2
2	ENGR 111	Introduction to ICT	2
3	ENGL 102	Technical Report Writing	2
4	SOCI 201	Principles of Sociology	2
5	PSYC 202	Principles of Psychology	2
6	ECON 301	Principles of Microeconomics	2
7	ECON 302	Engineering Economic Analysis	2
Total			**14**

9.2.2 Basic Science and Mathematics: Engineers need an understanding of natural laws to guide their creativity. They need the analytical skills to develop technically sound solutions. International accreditation bodies generally require basic science and mathematics in Bachelor of Science degree programmes. Typical requirement for science and mathematics together is a minimum of 30 credit-hours.

Basic sciences are disciplines focused on knowledge or understanding of the fundamental aspects of natural phenomena. Basic sciences in this programme consist of chemistry and physics courses. College-level mathematics requires a degree of sophistication at least equivalent to that of introductory calculus. For illustrative purposes, some examples of college-level mathematics include calculus, differential equations, probability, statistics, linear algebra, and discrete mathematics. Table 4 provides the list of Basic Science and Mathematics Courses in the programme.

Table 4. Required Science and Mathematics Courses

No	Course Code	Course Title	Credit Hours
1	CHEM 101/111	Applied Chemistry/Lab	4
2	PHYS 102/112	Applied Physics I/Lab	4
3	PHYS 201/211	Applied Physics II/Lab	4
4	MATH 101	Calculus I	3
5	MATH 102	Calculus II	3
6	MATH 221	Numerical Methods	3
7	MATH 201	Mathematical Analysis	3
8	MATH 202	Differential Equations	3
9	MATH 303	Engineering Statistics	3
Total			**30**

9.2.3 Electrical Engineering Topics: Engineering topics consist of engineering science, engineering principles and engineering design. Engineering sciences are based on mathematics and basic sciences but carry knowledge further toward creative application needed to solve engineering problems. These studies provide a bridge between mathematics and basic sciences on the one hand and engineering practice on the other.

Engineering principles require the application of discipline-specific knowledge and skills to solve complex engineering problems involving wide-ranging or conflicting technical issues, having no obvious solution, and addressing problems not encompassed by current standards and codes.

Engineering design is a process of devising a system, component, or process to meet desired needs and specifications within constraints. It is an iterative, creative, decision-making process in which the basic sciences, mathematics, and engineering sciences are applied to convert resources into solutions.

Table 5 provides a list of Engineering Topics in the BSc Electrical/Electronic Engineering Programme. The table shows the course number, course title and the number of credit hours allocated for each course. The course descriptions, student outcomes and course objectives are provided in Section 9.4.

Table 5. Electrical/Electronic Engineering Courses

No	Course Code	Course Title	Credit Hours
1	ELEN 121	Introduction to Electrical Engineering	2
2	ENGR 113	Engineering Graphics	2
3	ENGR 102	Fundamentals of Materials Science	2
4	ELEN 114	Electrical Engineering Graphics	2
5	ELEN 112	Electrical Shop Practices	2
6	ELEN 222	Electrical Engineering Materials	3
7	MEEN 201	Engineering Mechanics – Statics	3
8	ELEN 221	Programming in "C"	2
9	ELEN 204/214	Electric Circuit Analysis/LAB	3
10	MEEN 204/214	Fundamentals of Thermodynamics/LAB	3
11	MEEN 202	Engineering Mechanics – Dynamics	3
12	ELEN 307/317	Control Systems/LAB	3
13	ELEN 309	Circuit Theory	3
14	ELEN 303	Digital Systems and Networks	3
15	ELEN 305	Electromagnetics	3
16	ELEN 302/312	Asynchronous and DC Electric Machines/LAB	3
17	ELEN 304/314	Power Electronics/LAB	3
18	ELEN 306	Digital Communication Systems	3
19	ELEN 326	Electrical Measurements and Instrumentation	3
20	ELEN 401/411	Synchronous Machines/LAB	3
21	ELEN 403/413	Power System Operation & Control/LAB	3
22	ELEN 405/415	Power Generation and Supply/LAB	3
23	ELEN 402/412	Digital Signal Processing/LAB	3
24	ELEN 422	Electrical Services Design	3
25	ELEN 424	Electrical Maintenance and Repair	3
28	ELEN 497	Electrical Capstone Project – Design	3
29	ELEN 498	Electrical Capstone Project – Prototype	4
Total			**76**

9.2.4 Innovation and Entrepreneurship Requirement: Table 6 provides a list of Innovations and Entrepreneurship Topics in the BSc Electrical Engineering Programme.

Table 6. Innovation and Entrepreneurship Courses

No	Course Code	Course Title	Credit Hours
1	ENGR 103	Introduction to Entrepreneurship	2
2	ENGR 116	Introduction to Innovation Projects	2
3	ENGR 201	Enterprise Development	2
4	ENGR 212	Intermediate Innovation Project I	2
5	ENGR 301	STEM Entrepreneurship	2
6	ENGR 316	Intermediate Innovation Project II	2
7	ENGR 423	Entrepreneurship Project	4
Total			**16**

9.2.5 Industrial Internship Requirement: Industry Practical Training is a required component of the programme. All students are required to satisfactorily complete a minimum of twenty-four (24) weeks

of industry attachment during the course of the programme. Table 7 provides information on the industrial attachment.

Table 7. Industrial Attachment

No	Course Code	Course Title	Weeks
1	ENGR 100	First Industrial Internship	6
2	ENGR 200	Second Industrial Internship	8
3	ENGR 300	Third Industrial Internship	10
Total			**24**

9.3 Semester-by-Semester Course Schedule

The Table 8 to Table 16 below provide the required courses, their lecture-hours, laboratory-hours and the total number of credit hours. As a reference, one (1) lecture credit-hour corresponds to 50 minutes of classroom interaction. One (1) laboratory credit-hour corresponds to 2 hours of laboratory work.

The maximum number of contact hours per semester was based on five (5) hours per day and 5 days per week which totals 25 hours. The semester-by-semester course load takes this into consideration to enable students to interact with colleagues and to engage in other extracurricular activities for student development. Table 8 through Table 16 provide the necessary information on the semester-by-semester course schedule.

Table 8. Year I – Semester I

Course Code	Course Title	Lecture Hours	Lab Hours	Credit Hours
ENGL 101	English Communication	2	0	2
MATH 101	Calculus I	3	0	3
CHEM 101	Applied Chemistry	3	0	3
CHEM 111	Applied Chemistry Lab	0	2	1
ELEN 121	Introduction to Electrical Engineering	1	2	2
ENGR 113	Engineering Graphics	0	4	2
ENGR 111	Introduction to ICT	0	4	2
ENGR 103	Introduction to Entrepreneurship	2	0	2
Total Hours		**11**	**12**	**17**

Table 9. Year 1: Semester Two

Course Code	Course Title	Lecture Hours	Lab Hours	Credit Hours
ELEN 112	Electrical Shop Practices	0	4	2
MATH 102	Calculus II	3	0	3
PHYS 102	Applied Physics I	3	0	3
PHYS 112	Applied Physics I Lab	0	2	1
ENGR 102	Fundamentals of Materials Science	2	0	2
ELEN 114	Electrical Engineering Graphics	0	4	2
ENGL 102	Technical Report Writing	2	0	2
ENGR 116	Introduction to Innovation Projects	0	4	2
Total Hours		**10**	**14**	**17**
ENGR 100 First Year Internship – 6 Weeks at 40 Hours per Week			**240**	**0**

Table 10. Year 2: Semester I

Course Code	Course Title	Lecture Hours	Lab Hours	Credit Hours
PHYS 201	Applied Physics II	3	0	3
PHYS 211	Applied Physics II Lab	0	2	1
MATH 221	Numerical Methods with MATLAB	2	2	3
MATH 201	Mathematical Analysis	3	0	3
ELEN 221	Programming in "C"	1	2	2
MEEN 201	Engineering Mechanics I – Statics	3	0	3
SOCI 201	Introduction to Sociology	2	0	2
ENGR 201	Enterprise Development	2	0	2
Total Hours		**16**	**6**	**19**

Table 11. Year 2: Semester 2

Course Code	Course Title	Lecture Hours	Lab Hours	Credit Hours
MEEN 202	Engineering Mechanics – Dynamics	3	0	3
MEEN 204	Fundamentals of Thermodynamics	3	0	3
ELEN 222	Electrical Engineering Materials	2	2	3
ELEN 204	Electric Circuit Analysis	2	0	2
ELEN 214	Electric Circuit Analysis Lab	0	2	1
MATH 202	Differential Equations	3	0	3
PSYC 202	Introduction of Psychology	2	0	2
ENGR 212	Intermediate Innovation Project I	0	4	2
Total Hours		**15**	**8**	**19**
ENGR 200 Second Year Internship – 8 Weeks at 40 Hours per Week			**320**	**0**

Table 12. Year 3: Semester 1

Course Code	Course Title	Lecture Hours	Lab Hours	Credit Hours
MATH 303	Engineering Statistics	3	0	3
ELEN 303	Digital Systems and Networks	3	0	3
ELEN 305	Electromagnetics	3	0	3
ELEN 307	Control Systems	2	0	2
ELEN 317	Control Systems Lab	0	2	1
ELEN 309	Circuit Theory	3	0	3
ECON 301	Principles of Microeconomics	2	0	2
ENGR 301	STEM Entrepreneurship	2	0	2
Total Hours		**18**	**2**	**19**

Table 13. Year 3: Semester 2

Course Code	Course Title	Lecture Hours	Lab Hours	Credit Hours
ELEN 302	Asynchronous and DC Electric Machines	2	0	2
ELEN 312	Electric Machines Lab	0	2	1
ELEN 304	Power Electronics	2	0	2
ELEN 314	Power Electronics Lab	0	2	1
ELEN 306	Digital Communication	3	0	3
ELEN 326	Electrical Measurements and Instrumentation	1	4	3
ECON 302	Engineering Economic Analysis	2	0	2
ENGR 316	Intermediate Innovation Project II	0	6	3
Total Hours		**10**	**14**	**17**
ENGR 300 Third Year Internship – 10 Weeks at 40 Hours per Week			**400**	**0**

Table 14. Year 4: Semester 1

Course Code	Course Title	Lecture Hours	Lab Hours	Credit Hours
ELEN 401	Synchronous Machines	2	0	2
ELEN 411	Synchronous Machines Lab	0	2	1
ELEN 403	Power Systems Operation and Control	2	0	2
ELEN 413	Power Systems Operation Lab	0	2	1
ELEN 405	Power Generation and Supply	2	0	2
ELEN 415	Power Generation Lab	0	2	1
ELEN 497	Capstone Project I	1	4	3
ENGR 423	Entrepreneurship Project	1	4	3
Total Hours		**8**	**14**	**15**

Table 15. Year 4: Semester 2

Course Code	Course Title	Lecture Hours	Lab Hours	Credit Hours
ELEN 402	Signal Processing	2	0	2
ELEN 412	Signal Processing Lab	0	2	1
ELEN 422	Electrical Services Design	1	4	3
ELEN 424	Electrical Maintenance and Repair	1	4	3
ELEN 498	Capstone Project I	1	6	4
Total Hours		**5**	**16**	**13**

Table 16. Programme Workload Analysis- Electrical/Electronic Engineering

Year	Semester	Lecture Hours	Lab Hours	Contact Hours	Credit Hours
Year 1	Semester 1	11	12	25	17
	Semester 2	10	14	24	17
Year 2	Semester 1	16	6	22	19
	Semester 2	15	8	23	19
Year 3	Semester 1	18	2	20	19
	Semester 2	10	14	24	17
Year 4	Semester 1	8	14	22	15
	Semester 2	5	16	21	13
Totals		**93**	**86**	**181**	**136**

9.4 Course Descriptions with Learning Outcomes and Course Objectives

The Lecture Hours, Laboratory/Practical Hours and the Total Number of Credit Hours for each course are indicated in brackets as: (Teaching Hours -Lab/Practical Hours - Total Credit Hours)

FIRST YEAR COURSES

ENGL 101 English Communication (2-0-2)

This course deals with communication processes, skills in communication, channels of communication in an organisation, preparation of official documents such as letters, memos, reports, minutes, and proposals. Oral presentation skills, formal speech making, conducting interviews and meetings are covered.

Learning Outcome: This course enables the student to demonstrate an ability to communicate effectively with a range of audiences.

Course Objectives: Upon completion of this course, students will be able to:

- Explain communication processes.
- Demonstrate skills in communication
- Describe the channels of communication in an organisation
- Prepare official documents such as letters, memos, reports, minutes and proposals.
- Demonstrate Oral presentation skills
- Explain Formal speech making
- Conduct interviews and meetings

MATH 101 Calculus I (3-0-3)

This course deals with limits and continuity of functions, the derivative, applications of the derivative, the definite integral and applications of the definite integrals.

Learning Outcome: This course introduces the student to the application of mathematics to the principles of science and engineering.

Course Objectives: By the end of the course, students will be able to:

- Explain limits and continuity of functions, the derivative and the definite integral.
- Apply the derivative and definite integral

CHEM 101 Applied Chemistry (3-0-3)

This course introduces basic principles and theoretical concepts of chemistry that form a prerequisite to the study of materials science. Topics will include atomic structure, electronic configuration, the wave mechanical model of the atom, chemical bonding, states of matter, chemical equilibria, systems of acids and bases, and electrochemistry.

Learning Outcome: This course enables the student to demonstrate an ability to identify, formulate, and solve problems by applying principles of science and mathematics.

Course Objectives: Upon successful completion of the course, students will be able to:

- Explain the basic principles and important theoretical concepts of chemistry as a prerequisite to materials science
- Describe atomic structure, electronic configuration, the wave mechanical model of the atom, and chemical bonding,
- Explain the states of matter, equilibria, systems of acids and bases, and electrochemistry.

CHEM 111 Applied Chemistry Laboratory (0-2-1)
This is a course which emphasizes quantitative studies of chemical reactions such as acid-base studies, redox reactions, and equilibrium reactions. Emphasis is also placed on the development of manipulative skills in the laboratory.

Learning Outcome: This course introduces the student to an ability to develop and conduct appropriate engineering experiment, analyse, and interpret data, and use engineering judgment to draw conclusions.

Course Objectives: By the end of the course, students will be able to:

- Follow procedures to conduct quantitative laboratory studies of chemical reactions such as acid-base studies, redox reactions, and equilibrium reactions
- Develop manipulative skills in the laboratory.

ELEN 121 Introduction to Electrical and Electronic Engineering (1-2-2)
This course provides an overview of elelctrical engineering. The role of the engineer in the interdisciplinary technical team will be discussed. Engineering functions, professional licensure, code of ethics, safety, the design process, teamwork, and legal responsibilities will be introduced. Case studies in ethics and the application of the design process through a team project are required.

Student Learning Outcome: This course introduces the ability of the student to identify, formulate, and solve simple electrical engineering problems by applying principles of engineering, science, and mathematics.

Course Objectives: Upon successful completion of this course, students will be able to:

- Explain electrical engineering profession.
- Describe the role of the engineer in the interdisciplinary technical team.
- Explain electrical engineering functions, professional licensure, code of ethics, safety, the design process, teamwork, and legal responsibilities
- Discern unethical behavior in engineering practice.
- Describe stages of the design process.
- Gain experience in a team project.

ENGR 113 Engineering Graphics (0-4-2)
This course introduces the students to standards and conventions of engineering drawings. It covers concepts of orthographic and isometric projections, the ability of conveying engineering information through drawings, develop the ability of producing engineering drawings using freehand sketches. The course also enables students to use a computer aided drafting package for the generation of basic engineering drawings.

Student Learning Outcome: This course introduces the student to the ability to communicate technical ideas in graphical form.

Course Objectives: At the end of the course, students will be able to:

- Apply standards and conventions of engineering drawings
- Apply the concepts of orthographic and isometric projections
- Develop the ability of conveying the engineering information through drawings
- Develop the ability of producing engineering drawings using freehand sketches
- Apply a basic computer aided drafting package for the generation of basic engineering drawings.

ENGR 111 Introduction to Information Communication Technology (2-0-2)

The course deals with computer hardware, specifications and software. Topics include Windows system and word processing, Spreadsheet, Databases, and Graphic Publications and presentation. Internet facilities and electronic mail. Introduction to computer programming using an available programming language.

Learning Outcome: This course enables students to demonstrate an ability to communicate effectively using computer technology to a wide range of audiences.

Course Objectives: By the end of the course, students will be able to:

- Determine computer hardware, specifications and software for engineering applications
- Use Windows and word processing, Spreadsheet, Databases
- Practice Graphic Publications and presentation.
- Operate Internet facilities and electronic mail.

ENGR 103 Introduction of Entrepreneurship (2-0-2)

This course covers introduction to core concepts in entrepreneurship. This includes Creativity/Creative thinking, The entrepreneurial mindset, Innovation, Opportunity, Value creation, Entrepreneurship Typology, Organizational, Social, and Sustainable Technology. Problem based learning including Problem solving frameworks, thinking tools, and 'Live' Case studies are treated in this course.

Learning Outcome: This course introduces students to an ability to apply innovation and entrepreneurial concepts to develop marketable products with accompanying business plans.

Course Objectives: By the end of the course, students will be able to:

- Explain what is meant by entrepreneurship.
- Describe the importance of ethics in entrepreneurial activity.
- Gather market feedback about a new product or service.
- Explain the concepts of types of profit (gross and net)
- Estimate the initial start-up costs for a new company.
- Compare the concepts of net worth (individual) and equity (company)

ELEN 112 Electrical Engineering Practices (0-4-2)

This course covers familiarisation tour of electrical engineering facilities, equipment identification in the laboratories, electrical safety measures. It includes Electronic/Autotronic- Identification of electronic components, PCBs, soldering, automobile checklists. Electrical-Identification of electrical machines and parts, identification of power cables, measuring instruments, relays and contactors, electrical wiring: types of switches, wires, lights, fans, heaters, fridges, air conditioners.

Learning Outcome: This course introduces the students to the ability to identify, formulate, and solve simple electrical engineering problems by applying principles of engineering, science, and mathematics.

Course Objectives: Upon completion of this course, students will be able to:

- Identify electrical engineering facilities.
- Describe electrical safety measures.
- Explain the use of PCBs and methods of soldering.
- Describe the operations of electrical machines.
- Explain the use of measuring instruments, relays and contactors.
- Describe the processes in electrical wiring with the knowledge of electrical wiring components like switches, lights, fans, heaters, fridges and air conditioners.

MATH 102 Calculus II **(3-0-3)**

Topics in analytical geometry, differentiation and integration of exponential, logarithmic, trigonometric, inverse trigonometric and hyperbolic functions, additional techniques and applications of integration, indeterminate forms, improper integrals, Taylor's Formula and infinite series will be covered.

Learning Outcome: This course introduces the student to the application of mathematics to the principles of science and engineering.

Course Objectives: By the end of the course, students will be able to:

- Have proficiency in analytical geometry.
- Perform differentiation and integration of exponential, logarithmic, trigonometric, inverse trigonometric and hyperbolic functions.
- Apply integration, indeterminate forms, and improper integrals to engineering problems.
- Apply the Taylor's Formula and infinite series to engineering problems.

PHYS 102 Applied Physics I **(3-0-3)**

This physics course covers the fundamental principles of Newtonian mechanics, heat, and thermodynamics. This course provides the prerequisite knowledge in engineering mechanics and the thermal sciences.

Learning Outcome: This course enables the student to demonstrate an ability to identify, formulate, and solve technical problems by applying principles of science and mathematics.

Course Objectives: By the end of the course, students will be able to:

- Apply the fundamental principles of Newtonian mechanics principles to engineering problems.
- Apply the fundamental principles of heat and thermodynamics to engineering problems.
- Solve basic engineering mechanics problems.
- Solve basic thermal science problems.

PHYS 112 Applied Physics I Laboratory **(0-2-1)**

This is a laboratory course in which a selected group of physics experiments in Newtonian mechanics, heat, and thermodynamics will be performed. Emphasis is placed on the development of experimental technique, analysis of data, and physical interpretation of experimental results.

Learning Outcome: This course enables the student to demonstrate an ability to develop and conduct appropriate engineering experiment, analyse, and interpret data, and use engineering judgment to draw conclusions.

Course Objectives: By the end of the course, students will be able to:

- Follow procedures and conduct experiments in Newtonian mechanics,
- Follow procedures and conduct experiments in heat and thermodynamics.
- Develop experimental techniques to study physical systems.
- Analyse experimental data and interpret experimental results.

ENGR 102 Fundamentals of Materials Science **(2-0-2)**

This course deals with the relationships between the structure of materials and their properties and performance. Topics include: atomic structure and chemical bonding, crystal structure, imperfections in solids, diffusion, mechanical, electrical, magnetic, and optical properties of materials.

Learning Outcome: This course enables the student to demonstrate an ability to identify and describe properties of engineering materials by applying principles of science and mathematics.

Course Objectives: At the end of the course, students will be able to:

- Describe the relationships between the structure of materials and their properties
- Explain atomic structure and chemical bonding, and crystal structure.
- Explain the differences between metals, polymers and ceramics.
- Explain imperfections in solids.
- Describe diffusion phenomena.
- Explain the science behind the properties of mechanical, electrical, magnetic, and optical materials.

ELEN 114 Electrical Engineering Graphics (0-4-2)

This course introduces the student to electrical and electronic symbols; wiring, connection or breadboarded diagrams; schematic diagrams; printed circuit diagrams; electrical power diagrams. Computer-aided-graphics is introduced.

Student Learning Outcome: This course enables the student to communicate ideas through computer modelling and graphics.

Course Objectives: Upon successful completion of the course, students will be able to:

- Demonstrate electrical design ideas using computer aided graphics.
- Demonstrate the use of simulation software for optimal designs.
- Demonstrate the process of transferring schematic diagrams into breadboards.
- Explain the processes of transferring electrical diagrams to printed circuit boards.

ENGL 102 Technical Report Writing (2-0-2)

This course includes the study and practice of the basic techniques of writing and editing scientific and technical materials. It covers elements of layout, design, and typography, giving students practice with short and long print texts and non-print texts and non-print media and referencing.

Learning Outcome: This course enables the student to demonstrate an ability to communicate effectively with a range of audiences in written and oral forms.

Course Objectives: By the end of the course, students will be able to:

- Explain basic technique of writing and editing of scientific and technical materials
- Explain elements of layout, design, and typography, of print material
- Practice short and long print texts, non-print texts and non-print media

ENGR 116 Introduction to Innovation Projects (0-4-2)

This course is an introduction to the role of innovation in entrepreneurship. This course aims at the generation of new innovations based on an established need or challenge. This includes brainstorming, product ideas, design concepts and customer needs, final concept development, and presentation material/investor pitching. The course includes a design & innovation group project.

Learning Outcome: This course introduces students to demonstrate an ability to apply innovation and entrepreneurial concepts to develop marketable products with accompanying business plans.

Course Objectives: By the end of the course, students will be able to:

- Identify the role of innovation in entrepreneurship
- Apply innovation to engineering start-ups
- Identify the forms and features of Innovation and factors that influence innovation.
- Describe the innovation process and its stages in engineering.

SECOND YEAR COURSES

PHYS 201 Applied Physics II (3-0-3)

This is a continuation of General Physics I. It covers the fundamental principles of electricity, magnetism, wave motion, and lasers and optics. This course provides the prerequisite knowledge in electrical circuits and power.

Learning Outcome: This course enables the student to demonstrate an ability to identify, formulate, and solve problems by applying principles of science and mathematics.

Course Objectives: By the end of the course, students will be able to:

- Apply the fundamental principles of electricity principles to engineering problems.
- Apply the fundamental principles of magnetism, wave motion to engineering problems.
- Solve basic engineering electrical problems.
- Solve basic wave and optical problems.

PHYS 211 General Physics II Laboratory (0-2-1)

This course is a continuation of General Physics I Laboratory. This is a laboratory course where a selected group of physics experiments in electricity, magnetism, wave motion, and optics will be performed. Emphasis is placed on the analysis of data and physical interpretation of experimental results.

Learning Outcome: This course enables students to demonstrate an ability to develop and conduct appropriate engineering experiment, analyse, and interpret data, and draw conclusions.

Course Objectives: By the end of the course, students will be able to:

- Design experiments on the fundamental principles of electricity
- Design experiments on the fundamental principles of magnetism and wave motion
- Design experiments on the fundamental principles of lasers and optics
- Test electrical circuits and power.

MATH 221 Numerical Methods and MATLAB (2-2-3)

This course introduces MATLAB programming language and the applications in solving problems in linear algebra, matrix theory, and manipulation of polynomials, interpolation, differentiation and integration.

Learning Outcome: This course enables students to demonstrate an ability to apply modern methods to solve complex mechanical engineering problems.

Course Objectives: By the end of the course, students will be able to:

- Produce working programmes to analyze engineering problems using MATLAB
- Apply MATLAB programming language
- Apply MATLAB programming language to solve problems in linear algebra, matrix theory
- Apply MATLAB programming language for manipulation of polynomials, interpolation, differentiation and integration.

MATH 201 Mathematical Analysis (3-0-3)

This course deals with vector and scalar fields including products of two, three or more vectors, vector differentiation and integration. Gradient, divergence, curl and their physical significance. Three dimensional coordinate geometry of lines and planes. Introduction to complex numbers. Elementary functions of complex variable. Determinants and their properties. Solution of a set of linear equations,

Crammer's rule. Matrices and their properties; characteristics functions, Eigen values and Eigen vectors. Introduction to linear programming.

Learning Outcome: This course reinforces the ability of the students to solve complex mechanical engineering problems by applying principles of mathematics.

Course Objectives: By the end of the course, students will be able to:

- Evaluate Vector, Scalars, Vectors and Scalar Fields
- Evaluate Products of two, three or more vectors
- Perform Vector differentiation and integration.
- Explain gradient, divergence, curl and their physical significance
- Apply three-dimensional coordinate geometry of lines and planes.
- Identify elementary functions of complex variable.
- Apply determinants and their properties.
- Solve a set of linear equations using Crammer's rule
- Apply Matrices and their properties;
- Develop and apply Eigen values and Eigen vectors.
- Apply linear programming to solve engineering problems.

ELEN 221 Programming in "C" (1-2-2)

This course introduces students into the C programming language and its application to algorithm development, solution to complex electrical engineering problems and designs. Topics include: Unix, Dialects of C, Common C: writing the program, compiling the program, the C compiler (cc), Program Builder, Improved Type Checking Using Lint, Running the Program, Global Variables, External Variables, Static Variables; Constants and Arrays, Assignment Statement, Arithmetic Operators, Type Conversion, Comparison, Logical Connectors and Control Statements.

Learning Outcomes:

An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Course Objectives: By the end of the course, students will be able to:

- Explain the peculiarities and objects of 'C' programming languages.
- Apply 'C' programming languages in solving numerical problems.
- Describe the process of writing, compiling and debugging a program.
- Describe the variable syntaxes, constants, arrays and operators.
- Describe the handling of files and structures in 'C'.
- Describe the UNIX library functions and the associates.
- Describe the formatted input and output function types.

MEEN 201 Engineering Mechanics I – Statics (3-0-3)

This course covers fundamental vector concepts of force, moment of a force; analytical and graphical techniques in the analysis of force and moment; conditions of equilibrium in frames, trusses, machine members under static loads; laws of friction; distributed forces, determination of centroid, mass center, area and mass moment of inertia. The course includes application of simple computer tools to solve problems.

Learning Outcome: This course enables students to demonstrate an ability to identify, formulate, and solve fundamental engineering problems by applying principles of engineering, science, and mathematics.

Course Objectives: Upon successful completion of the course, students will be able to:

- Resolve forces and determine the resultant.
- Draw free body diagrams for particles.
- Apply vectors for resultant and equilibrium analysis.
- Analyze pulley systems.
- Draw free body diagrams and analyze rigid bodies and trusses.
- Draw free body diagrams and analyze machines.
- Analyze static friction situations.
- Calculate center of gravity and centroids
- Apply simple computer tools to solve problems.

SOCI 201 Principles of Sociology (2-0-2)

In this course, basic concepts and principles in sociology as they are used to examine patterned and recurrent forms of social behaviour will be studied. Similarities and differences between structural functionalism, conflict theory and symbolic interactionism will be covered.

Learning Outcome: This course enables students to identify technological needs considering public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors in engineering practice.

Course Objectives: By the end of the course, students will be able to:

- Explain the basic concepts and principles in sociology
- Understand the development of sociological perspectives.
- Discuss the historical nature of sociology.
- Explain what sociological theories are and how they are used.
- Examine patterned and recurrent forms of social behaviour.
- Identify ways sociology is applied in the real world.

ENGR 201 Enterprise Development (2-0-2)

This course covers Entrepreneurial Functional Knowledge, Entrepreneurial Perspective Knowledge, and Business Development. Topics include Strategy, Marketing, Organisational Design, People Oriented Practice, Leadership, Finance and Operations. Stakeholder Engagement & Inclusion, STEM-Entrepreneurship Nexus, and Business Plan development

Learning Objectives: This course enables students to demonstrate an ability to apply innovation and entrepreneurial concepts to develop marketable products with accompanying business plans.

Course Objectives: By the end of the course, students will be able to:

- Explain decisions and actions taken by entrepreneurs to mitigate risk,
- Apply the principles of an entrepreneurial mindset.
- Explain how to discover opportunities in life.
- Discuss how to finance entrepreneurship activity.
- Develop a business plan

MEEN 202 Engineering Mechanics II – Dynamics (3-0-3)

This course covers the fundamental principles of mechanics applied to the motion of particles, systems of particles and rigid bodies; kinematics; rectilinear and curvilinear motions; kinetics: force, mass, and acceleration; energy and momentum principles. The course also includes the use of computational tools to solve numerical problems.

Learning Outcome: This course enables students to demonstrate an ability to identify, formulate, and solve complex mechanical engineering problems by applying principles of engineering, science, and mathematics.

Course Objectives: By the end of the course, students will be able to:

- Apply theories of motion to particles and rigid bodies.
- Evaluate displacement, velocity and acceleration of rectilinear motions.
- Analyze displacement, velocity and acceleration of curvilinear motions.
- Analyze force, mass, and acceleration for particles and rigid bodies.
- Apply energy and momentum principles to analyze motions.
- Use MATLAB to solve numerical problems of motion.

MEEN 204 Fundamentals of Thermodynamics (3-0-3)

This course deals with fundamental thermodynamic principles. The topics covered include energy, heat and work, thermodynamic properties of substances, real and ideal gases, first and second laws of thermodynamics from a macroscopic viewpoint, the basic thermodynamic cycles.

Learning Outcome: This course enables students to demonstrate an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.

Course Objectives: By the end of the course, students will be able to:

- Explain the fundamental thermodynamic principles
- Discuss the relationship among energy, heat and work.
- Evaluate thermodynamic properties of substances.
- Distinguish between real and ideal gases
- Apply first and second laws of thermodynamics from a macroscopic viewpoint
- Analyze basic thermodynamic cycles.

ELEN 222 Electrical Engineering Materials (2-2-3)

This course gives the students the ability to relate atomic, molecular, and crystal structure on the electrical and physical properties of conducting, insulating and semiconductor materials used in electrical engineering.

Learning Outcomes: This course enables students to acquire and apply new knowledge as needed, using appropriate learning strategies.

Course Objectives: By the end of the course, students will be able to:

- Explain the atomic, molecular and crystal structure of electrical engineering materials.
- Describe the electrical and physical properties of conducting materials.
- Distinguish between conductors, semiconductors and insulating materials used in electrical engineering.

ELEN 204 Electric Circuit Analysis (3-0-3)

This course covers circuit analysis using Kirchhoff's Laws, loop and nodal analysis, Thévenin's and Norton's theorems, etc., for resistive circuits with DC sources. The transient behavior of first and second order (RC, RL, and RLC) circuits and steady state sinusoidal analysis are also covered.

Learning Outcomes: This course enables students to identify, formulate, and solve complex electrical engineering problems by applying principles of engineering, science, and mathematics.

Course Objectives: By the end of the course, students will be able to:

- Apply analytical techniques in solving electrical circuit problems.
- Describe suitable electrical circuit laws to obtain electrical signals.
- Describe transient behavior of RC, RL, and RLC circuits.
- Apply appropriate filter design to achieve a desired result.
- Describe the process of analysis of transient and steady state electrical circuit.

ELEN 214 Electric Circuit Analysis Laboratory (0-2-1)

This course covers the proper use of laboratory instrumentation, principles of measurements, experimental verification of transient and steady state response, frequency response, and resonance of systems with linear passive elements. Theoretical analyses and computer simulations of networks are compared with laboratory experimental results using actual circuits.

Learning Outcomes: This course enables students to demonstrate an ability to develop and conduct appropriate engineering experiment, analyse, and interpret data, and draw conclusions.

Course Objectives: By the end of the course, students will be able to:

- Describe the application of various instrumentation devices.
- Apply various instrumentation devices in measuring and recording measurands.
- Describe the transient and steady state as well as resonance of systems with linear passive elements.
- Compare computer simulation results with laboratory experimental results.

MATH 202 Differential Equations (3-0-3)

This course covers development and solution of first order differential equations, higher order linear differential equations, matrices and determinants, systems of linear algebraic equations, systems of linear differential equations, and Laplace transforms.

Learning Outcome: This course enables students to demonstrate an ability to identify, formulate, and solve complex mechanical engineering problems by applying principles of engineering, science, and mathematics.

Course Objectives: By the end of the course, students will be able to:

- Solve first order differential equations.
- Solve higher order linear differential equations.
- Describe systems of linear algebraic equations
- Identify systems of linear differential equations
- Describe Laplace transforms.
- Apply matrices and determinants.

PSYC 202 Principles of Psychology (2-0-2)

This course provides an introduction to psychology. Topics given major consideration include maturation and development, motivation, emotion, and personality; mental health, intelligence, and aptitude; perception and attention; learning, forgetting, language, and thinking; social influence, attitudes, beliefs, and vocational adjustments.

Learning Outcome: This course enables students to identify technological needs considering public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors in engineering practice.

Course Objectives: By the end of the course, students will be able to:

- Apply principles of human psychology
- Discuss maturation and development.
- Discuss motivation, emotion, personality, and mental health.
- Analyze social influence, attitudes, beliefs, and vocational adjustments.

ENGR 212 Intermediate Innovation Project I (0-4-2)

This course deals with how a transfer of elements from the developmental stage to practice for industrial products; Improvement of customer integration activities in the product innovation process and the innovativeness of the resulting new products.

Learning Outcome: This course enables students to demonstrate an ability to apply innovation and entrepreneurial concepts to develop marketable products with accompanying business plans.

Course Objectives: By the end of the course, students will be able to:

- Transfer elements from the developmental stage to practice for industrial products
- Improve customer integration activities in the product innovation process
- Improve innovativeness of new products.

THIRD YEAR COURSES

MATH 303 Engineering Statistics (3-0-3)

This course deals with data presentation and analysis, frequency distributions, probability concepts and axioms of probability. Random variables, discrete and continuous probability distributions, calculus based probability calculations, joint distributions, conditional probability and independence are covered. Independence of events is applied to engineering system reliability. Students are introduced to concepts of sampling, sampling distributions, estimation, confidence intervals, and hypothesis testing.

Learning Outcome: This course enables students to demonstrate an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.

Course Objectives: By the end of the course, students will be able to:

- Analyze statistical data, generate frequency distributions,
- Apply probability concepts and axioms of probability.
- Describe Random variables and apply discrete and continuous probability distributions.
- Describe joint distributions, and apply conditional probability and independence.
- Apply concepts of sampling, and estimation to develop confidence intervals for lots
- Develop understanding of hypothesis testing
- Test for independence of events

ELEN 303 Digital Systems and Networks (3 0 3)

This course deals with Digital Devices and Circuits. Topics include number systems, boolean logic, logic gates and circuits, logic minimization, flip-flops, programmable logic devices, state machine design and timing. Design examples of Digital Systems are included.

Learning Outcomes: This course enables students to demonstrate the following:

1. An ability to identify, formulate, and solve complex electrical engineering problems by applying principles of engineering, science, and mathematics.
2. An ability to apply electrical engineering design processes to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social,
3. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Course Objectives: By the end of the course, students will be able to:

- Explain the concept of digital devices and circuits and its applications to solving complex engineering problems.
- Apply logic circuit design in electrical engineering systems.
- Apply knowledge of flip-flops and programmable logics in generating signals for switching devices.

ELEN 305 Electromagnetics (3-0-3)

This is a course in Electrostatics and electromagnetism. The content includes the electric fields, conductors, insulators, capacitance, the magnetic field in free space, magnetic effects of iron. Calculation of inductance, field plotting, electromagnetic induction Maxwell's equations differential plus integral form. Electromagnetic waves theory: EM waves in a homogeneous medium uniform plane wave propagation, conductors, dielectric, skin effect reflection, reflection of plane waves. Poynting Vector.

Learning Outcomes: This course enables students to demonstrate the following:

1. An ability to identify, formulate, and solve complex electrical engineering problems by applying principles of engineering, science, and mathematics.
2. An ability to analyse and design complex electrical and electronic devices.

Course Objectives: By the end of the course, students will be able to:

- Explain the concept of electrostatics and electromagnetism as they relate to conductors, insulators, capacitance and magnetic field in free space and in bodies.
- Apply the concept in calculating the inductance of a complex electrical systems.
- Describe Maxwell's equations both in differential and integral forms.
- Describe EM waves in a homogeneous medium and uniform plane.
- Apply EM wave propagation in conductors to determine dielectric, skin effect and reflection of plane waves in free space and in mediums.

ELEN 307 Linear Control Systems (2-0-2)

This course covers the principles of control theory course that includes control system modeling and representation, features of feedback control systems, state space representation, time domain analysis, root locus, and design compensation. Laplace transforms, mathematical modelling of physical processes. Transfer functions, signal flow diagrams, block diagram manipulation. Step, impulse and frequency response of linear systems. Bode Plots, Nyquist Plots, Root locus, Nichol's chart and application to design of compensators. Feedback, feedforward, and tacho feedback compensation. PID control, identification of linear systems, stability of linear systems.

Learning Outcomes: This course enables students to demonstrate:

An ability to identify, formulate, and solve complex electrical engineering problems by applying principles of engineering, science, and mathematics.

Course Objectives: By the end of the course, students will be able to:

- Describe the concept of control in electrical engineering systems.
- Describe the steps to arrive at a stable controlled system given the input and the system.
- Explain the application of state space representation, time domain analysis, root locus and other control techniques.
- Explain the use of mathematical modelling, transfer functions, signal flow graphs and block diagram manipulations in different control techniques.

- Explain the individual benefits of use of step impulse, frequency response, bode plots, Nyquist plots, root locus and Nichol's chart in ascertaining the stability or otherwise of controlled systems.
- Describe the impacts of feedback, feedforward and tacho feedback compensation in achieving stability in a complex control system.
- Explain the methods of obtaining control parameters for PID control system.

ELEN 317 Linear Control Systems Lab (0-2-1)

This laboratory course supports the theory of linear control systems. It covers digital storage oscilloscope, demonstration of magnetic levitation, servo motor control with different wave inputs, open loop DC motor control, demonstrations with twin rotor MIMO system, demonstrations with Nio robot control, closed loop and open loop walking experiments using Nao robot.

Learning Outcomes: This course enables students to demonstrate the following:
1. An ability to develop and conduct appropriate engineering experiment, analyse, and interpret data, and draw conclusions.
2. An ability to communicate effectively with a range of audiences.

Course Objectives: By the end of the course, students will be able to:
- Demonstrate the ability to carry out laboratory experiments through the use of digital storage oscilloscope.
- Demonstrate adequate knowledge of working principles of magnets.
- Explain operational principles and control of DC motor.
- Describe basic control operations of multiple input multiple output MIMO systems.
- Explain effective robotic human interaction chain.
- Explain open loop and closed loop principles through walking Nao robot.

ELEN 309 Electric Circuit Theory (3-0-3)

This course covers the application of Network theorems to AC Networks, Network Topology, Two port Networks, Multiport Networks, n-terminal networks and Two port devices.
Topics include Superposition, substitution, Thevenin, Duality; Norton; Reciprocity. Graph or network Trees, Node voltages and current equation. Use of nodal voltage method and mesh current method in network analysis. Relationship between terminal quantities; choice of parameters; network models; interconnection of networks; validity tests. Application of interconnection rules; Loaded two ports; Reciprocity and symmetry. Network equations; effect of dependent and independent internal sources. The indefinite admittance matrix; connection of a terminal to earth; connection of two terminals together; suppression of terminal; connection of networks in parallel. Impedance converter, generalized impedance converter, Negative impedance converter, impedance inverter, and the Gyrator.

Learning Outcomes: This course enables students to demonstrate an ability to identify, formulate, and solve complex electrical engineering problems by applying principles of engineering, science, and mathematics.

Course Objectives: Upon successful completion of this course, students should be able to do the following:
1. Analyze circuits subjected to different excitations.
2. Perform analysis of both transient and steady state of a circuit
3. Analyze and interpret locus and phasor diagram.
4. Analyze short, medium and long transmission lines

ECON 301 Principles of Microeconomics (2-0-2)

This course deals with the principles of economics related to individual segments of the society. Emphasis will be placed upon scarcity, supply and demand, consumer behaviour, business firms and market structures.

Learning Outcome: This course enables students to demonstrate an ability to consider economic factors in mechanical engineering design to produce solutions that meet specified needs.

Course Objectives: By the end of the course, students will be able to:

- Explain the principles of economics related to individual segments of the society
- Explain scarcity, supply and demand,
- Discuss consumer behaviour,
- Describe business firms and market structures.
- Discuss the need for economic and market considerations in engineering.

ENGR 301 STEM Entrepreneurship (2-0-2)

This course covers Entrepreneurial Integrative Abilities, Spiral to application to STEM/Translational Aspects, Experiential Learning. Topics include Design Thinking, Innovation & Markets, Innovation Management, Intellectual Property Protection, Prototyping, Stakeholder Engagement, and Services as it pertains to STEM. Experiential learning activities include development of innovation spirit, Blue Ocean strategies and Value Proposition Workshop.

Learning Outcome: This course enables students to demonstrate an ability to apply innovation and entrepreneurial concepts to develop marketable products with accompanying business plans.

Course Objectives: By the end of the course, students will be able to:

- Analyze the differences in social progress in the region
- Describe the role of the entrepreneur in society
- Identify the impact of entrepreneurial innovations on national cultures.
- Develop ways to involve stakeholders in their entrepreneurship endeavors.
- Describe intellectual property rights and how to apply for patents in The Gambia.

ELEN 302 Asynchronous and DC Machines (2-0-2)

This course covers armature winding, DC machines and polyphase induction machines. Topics include windings, Emf and Mmf Developed, basic theories, construction, characteristics, efficiencies, power factors, starting methods and industrial control circuits.

Learning Outcomes: This course enables students to demonstrate the following:

1. An ability to identify, formulate, and solve complex electrical engineering problems by applying principles of engineering, science, and mathematics.
2. An ability to analyse and design systems containing hardware and software components.

Course Objectives: By the end of the course, students will be able to:

- Describe the operational principles and theories of DC machines.
- Describe the winding and construction of DC machines.
- Explain the characteristics, efficiencies, power factors and starting methods of DC machines.
- Explain the number of industrial control methods for industrial machines.

ELEN 312 Electric Machines Lab (0-2-1)

This laboratory course covers measurements of circuit parameters and performance characteristics of DC motors and generators (separately excited, shunt, series, compound). Short circuits and open circuit tests of transformer, experimental determination of circuit parameters, efficiency and regulation measurements from load test, measurement and observation of harmonics in three phase connections.

Open circuit and short circuit tests of induction machines, load tests, circuit parameter and efficiency measurements.

Learning Outcomes: This course enables students to demonstrate an ability to develop and conduct appropriate engineering experiment, analyse, and interpret data, and draw conclusions.

Course Objectives: By the end of the course, students will be able to:

- Investigate the performance characteristics of DC motors and generators.
- Apply the needed knowledge for the testing of the open circuit and short circuit characteristics of transformer and induction machines.
- Explain the concept of efficiency, regulation and harmonics effects in three phase connected transformer.

ELEN 304 Power Electronics (2-0-2)

This course covers the principles and applications of thyristors and power transistors; A.C. line-commutated converters: rectification, inversion, commutation; A.C. characteristics, cycloconverter; A.C. and D.C. chopper, forced commutation, bridge, parallel and series inverters.

Learning Outcomes: This course enables students to demonstrate an ability to identify, formulate, and solve complex electrical engineering problems by applying principles of engineering, science, and mathematics.

Course Objectives: By the end of the course, students will be able to:

- Apply thyristors and power transistors in power electronics circuits.
- Apply the principles and operations of power converters in rectification and inversion.
- Design power electronics for industrial systems.
- Acquire and apply the knowledge of use of high voltage probe and current probe in the measurements of voltage and current.
- Explain the use of digital power meter in analyzing power quality parameters.
- Describe the use of digital storage oscilloscope in generating and measuring signals.
- Acquire the basic knowledge of the working principles of electric vehicle by identifying the operations of the constituent components.

ELEN 314 Power Electronics Lab (0-2-1)

This laboratory course supports the power electronics theory. Experiments include: verification of presence of low and high voltage, relays control current measurement, analyzing power quality parameters (voltage, current, harmonic, frequency, fluctuation, flicker, swell, sag, power) and three-phase unbalance of power supply line. Generating of standard waveforms, measurements of frequency, phase difference, rise time, fall time and delay time of signals. Generation and measurement of signals. Understanding the electric vehicle (traction battery pack,

Learning Outcomes: This course enables students to demonstrate the following:
1. An ability to develop and conduct appropriate engineering experiment, analyse, and interpret data, and draw conclusions.
2. An ability to communicate with the wide range of audiences.

Course Objectives: By the end of the course, students will be able to:

- Use high voltage probe and current probe in the measurements of voltage and current.
- Explain the use of digital power meter in analyzing power quality parameters.
- Utilize digital storage oscilloscope in generating and measuring signals.

- Acquire experience in the working principles of electric vehicles by identifying the operations of the constituent components.

ELEN 306 Digital Communication Systems (3-0-3)
The course covers the principles of signal sources, types, analysis and applications. Topics include modulation/demodulation concepts (eg. AM, FM, PCM), Fourier transforms, multiplexing (eg. Time division, frequency distribution), and digital communications.

Learning Outcomes: This course enables students to demonstrate an ability to analyse and design complex electrical and electronic devices.

Course Objectives: By the end of the course, students will be able to:
- Identify the types and sources of signals in digital communication systems.
- Explain the principle of transmission of digital signals in frequency modulation, amplitude modulation and pulse code modulation.
- Apply the concept of Fourier transforms, time division multiplexing and frequency distribution in digital communication.

ELEN 326 Electrical Measurement & Instrumentation (1-4-3)
This course deal with operational principles and dynamic analysis of measuring instruments: moving coil instruments, moving iron instruments; electrostatic, electrodynamics, industrial instruments; instrument transformers; measurement of current, voltage, power energy, phase, power factor, frequency; measurement of resistance, capacitance and inductance; bridge methods, resonance methods, sensors, and transducers; methods of measuring non-electric quantities: heat, light, sound, pressure, strain and stress.

Learning Outcomes: This course enables students to demonstrate the following:
1. An ability to develop and conduct appropriate engineering experiment, analyse, and interpret data, and draw conclusions.
2. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Course Objectives: By the end of the course, students will be able to:
- Use the application of moving coil and moving iron instruments in electrical measurements and instrumentation.
- Utilize the instrument transformers in electrical measurements.
- Select the instruments used in measuring current, voltage, power, energy, phase, power factor and frequency during practical experiments.
- Identify instruments used in measuring resistance, capacitance and inductance in a complex electrical circuit.
- Describe the methods of measuring non-electrical quantities like heat, light, sound, pressure, strain and stress.

ECON 302 Engineering Economic Analysis (2-0-2)
This course focuses on the concept of time value of money, cash flows, and the methods of evaluating alternatives based on present worth, annual worth, rate of return, payback period and cost benefit analysis. The course also covers breakeven analysis, replacement analysis, depreciation methods and the effect of income taxes and inflation on economic decisions.

Learning Outcome: This course enables the students to demonstrate an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.

Course Objectives: By the end of the course, students will be able to:

- Explain the concept of time value of money, cash flows
- Analyze present worth, annual worth, rate of return, payback period and cost benefit
- Perform breakeven, replacement, depreciation analysis of machines and equipment
- Explain income taxes and inflation on the economy.
- Apply cost accounting to engineering production systems.

ENGR 316 Intermediate Innovation Project II (0-6-3)

This course builds on the understanding gained from ENGR 212 to facilitate insight into how innovation process can be configured in engineering start-ups. Thus, this course provides experience in the evolution of approaches to innovation management, the stages of innovative activity in an enterprise, stages of innovative activity and the configuration options that are available to engineering entrepreneurs.

Learning Outcome: This course enables students to demonstrate an ability to apply innovation and entrepreneurial concepts to develop marketable products with accompanying business plans.

Course Objectives: By the end of the course, students will be able to:

- Configure innovation process in engineering start-ups.
- Explain the evolution of approaches to innovation management.
- State the stages of innovative activity in an enterprise.
- Describe the stages of innovative activity.
- Describe the configuration options that are available to engineering entrepreneurs.

FOURTH YEAR COURSES

ELEN 401 Synchronous Machines (2-0-2)

The course deals with construction phasor diagrams and Equivalent Circuit of Non-Salient pole Machine. Topics include Assessment of Reactance, Determination of Voltage Regulation, Synchronizing, effects of changing excitation and Mechanical Torque. Starting of Synchronous Motor and its industrial control circuit, Synchronous induction Motors, and Single-phase synchronous generators are covered.

Learning Outcomes: This course enables the students to demonstrate the following:

1. An ability to analyse and design complex electrical and electronic devices.
2. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Course Objectives: By the end of the course, students will be able to:

- Identify the benefits of phasor diagrams and equivalent circuit of synchronous machine.
- Apply voltage regulation and synchronization in synchronous machines.
- Demonstrate the application of industrial control of starting current and torque of synchronous machine.

ELEN 411 Synchronous Machines Lab (0-2-1)

This laboratory course covers harmonics evaluation of 3-phase IGBT based pwm inverter, starting methods of 1-phase and 3-phase ac machines, no load test on a 3-phase ac machine, conduct open circuit (no load) & short circuit (blocked rotor) tests on the machine. It also covers experiments on speed as a function of armature voltage in a separately-excited dc machine, basic digital design for advanced controllers using primer spartan 3 development kit, analog to digital conversion, FPGA based speed control of BLDC drive, synchronous speed control of a permanent magnet synchronous motor, speed control of 3-phase wound rotor induction motor.

Learning Outcomes: This course enables students to demonstrate an ability to develop and conduct appropriate engineering experiment, analyse, and interpret data, and draw conclusions.

Course Objectives: By the end of the course, students will be able to:

- Apply the process of evaluation of harmonics in a 3-phase pwm inverter.
- Demonstrate the starting methods open to single phase and three phase ac machines.
- Perform no load and blocked rotor tests of ac machines to determine their performance parameters.
- Perform tests to determine speed and torque characteristics of separately excited dc machines.
- Perform basic digital design for advanced controllers using primer spartan 3 development kit.
- Carry out experiments on FPGA based speed control of BLDC drives.
- Perform speed controls in PMSG and induction motor.

ELEN 403 Power System Operation and Control (2-0-2)

The controllability of electric power systems. The influence of controllability and the possible solution of the control problem. Control of equilibrium points. Static optimization. Frequency and load control. Voltage and reactive power control. Hierarchical control in power systems. The effect of voltage regulators on rotor angle damping. The role of the human operator. Optimal control of power system

Learning Outcomes: This course enables students to demonstrate the following:

1. An ability to identify, formulate, and solve complex electrical engineering problems by applying principles of engineering, science, and mathematics.
2. An ability to analyse and design systems containing hardware and software components.

Course Objectives: By the end of the course, students will be able to:

- Explain the operational principle of electrical power system.
- Describe various control techniques for electrical power system which include frequency and load control, voltage and reactive power control and hierarchical control.
- Describe the effect of voltage regulators on rotor angle damping and the role of human operator.
- Describe the process of achieving optimal control of power system.

ELEN 413 Power Systems Operation Lab (0-2-1)

This laboratory course covers study and connection of various types of protection schemes for 3-phase ac generator, theoretical and practical test of variety of industrial relays, power factor variation with static var compensator, evaluation of ABCD parameters of artificial transmission line, dc network analyser for fault calculations, adaptive power factor controller for three-phase induction generators and motors, numerical relay protection of electrical network from unexpected fault currents, air circuit protection of overcurrent and short-circuit for electric circuits, scada based electric power transmission system.

Learning Outcomes:

This course enables students to demonstrate an ability to develop and conduct appropriate engineering experiment, analyse, and interpret data, and draw conclusions.

Course Objectives: By the end of the course, students will be able to:

- Apply the methods of protection schemes for 3-phase ac generator.
- Apply static var compensator for power factor improvement.
- Utilize the evaluation method of ABCD parameters of transmission lines.
- Use dc network analyzer for the calculation of faults.

- Demonstrate the application of adaptive power factor control of 3-phase induction generators and motors.
- Demonstrate the use of air circuit breaker for the protection of electrical networks from unexpected fault currents.
- Perform experiments on scada based electric power transmission system.

ELEN 405 Power Generation and Supply (2-0-2)

This course covers energy sources, location and characteristics of fossil and nuclear fuel. Fuel processing and environmental and safety limitations. Thermal power plant, performance and efficiency of steam turbines, internal-combustion power plant, gas turbine, nuclear power plant, schematics of nuclear power plant; brief treatment of fission and fusion reaction and expected yield. Hydro power plants: principles of energy conversion using water. Criteria for siting of plant. Elements of hydroelectric plant, types of hydraulic turbines, performance and efficiency characteristics

Learning Outcomes: This course enables the students to demonstrate an ability to apply electrical engineering design processes to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.

Course Objectives: By the end of the course, students will be able to:

- Identify the forms and sources of energy.
- Identify the environmental and safety concerns of explorations of fossil and nuclear fuels.
- Apply the principle of operation of thermal plant in terms of thermodynamic cycles, energy conversion using steam.
- Assess the performance of steam turbines, internal combustion power plant and gas turbine.
- Demonstrate the operational principles of hydro power plants.

ELEN 415 Power Generation Lab (0-2-1)

This laboratory course covers electric power generation using electrical power system simulator PSS1, synchronization of the generator output to the grid, simulation of transmission lines of different lengths with reactances to model the characteristics of overhead or underground power cables, protection relaying to indicate position of line faults, electric power distribution to factories and households through distribution transformers resistive, capacitive, inductive and induction motor (dynamic) loads.

Learning Outcomes: This course enables students to demonstrate the following:

1. An ability to develop and conduct appropriate engineering experiment, analyse, and interpret data, and draw conclusions.
2. An ability to analyse and design complex electrical and electronic devices.

Course Objectives: By the end of the course, students will be able to:

- Demonstrate in the laboratory the process of electric power generation, through transmission to distribution.
- Identify the process of synchronization of generated electric power with the grid.
- Apply the relaying principle on the transmission line with a view to analyzing line faults.
- Utilize the principles of electric power distribution to different types of loads and the impacts of the different loads to the power system.

ELEN 497 Capstone Project I **(1-4-3)**

This is the first part of a two-course sequence which together prepare students for engineering practice. This is a major team design experience. The projects are based on the knowledge and skills acquired in earlier course work and incorporates multiple design constraints. Team design projects are continued during the following semester. Team oral presentations and written reports are required.

Learning Outcomes: This course provides the student to demonstrate the ability to:

1. Communicate effectively with a range of audiences.
2. Recognize ethical and professional responsibilities in engineering situations and make informed judgments.
3. Function effectively in a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
4. Acquire and apply new knowledge as needed, using appropriate learning strategies.
5. Analyse and design complex electrical and electronic devices.
6. Analyse and design systems containing hardware and software components.

Course Objectives:

- Identify and apply international and national codes and standards for the practice of electrical engineering.
- Work in a team to execute a project.
- Organize knowledge and skills acquired and incorporate multiple design constraints.
- Design, develop and test a product in a team.
- Work in a team to present oral project report.
- Work in a team to present a written project report.

ENGR 423 Entrepreneurship Project **(1-4-3)**

This course is a pre-requisite for the (MEEN 498) capstone project. The course discusses Innovative Eentrepreneurship in the field of Engineering, including developing business plans for innovative new ventures in Engineering.

Learning Outcome: This course enables students to demonstrate an ability to apply innovation and entrepreneurial concepts to develop marketable products with accompanying business plans.

Course Objectives: By the end of the course, students will be able to:

- Demonstrate competence in innovative entrepreneurship skills in the field of engineering.
- Develop business plans for innovative new ventures in engineering

ELEN 402 Signal Processing **(2-0-2)**

This course covers the concepts, terminology, and applications of digital signals processing. Topics include convolution (continuous and discrete) signals, difference equations, Z-transforms, Sampling (aliasing and Nyquist theorems), Analog and digital filters.

Learning Outcomes: This course enables students to demonstrate an ability to analyse and design systems containing hardware and software components.

Course Objectives: By the end of the course, students will be able to:

- Demonstrate the competence in the applications of digital signal processing in electrical and electronic engineering.
- Demonstrate the competence in the design of analog and digital filters.

ELEN 412 Signal Processing Lab (0-2-1)

This laboratory course covers simulation of signals, verification of the properties of discrete Fourier transform, familarization of digital signal processor hardware, linear convolution, fast Fourier transform of signals using decimation in time, inverse fast Fourier transform with fast Fourier transform, finite impulse response low pass filter, infinite impulse response filter design, overlap save block convolution,

Learning Outcomes: This course enables students to demonstrate an ability to develop and conduct appropriate engineering experiment, analyse, and interpret data, and use engineering judgment to draw conclusions.

Course Objectives: By the end of the course, students will be able to:

- Analyze the discrete time systems and to explain about FFT algorithms.
- Demonstrate the design techniques for FIR and IIR digital filters.
- Apply the finite word length effects in signal processing.
- Identify the properties of random signal, multirate digital signal processing and about QMF filters.

ELEN 422 Electrical Services Design (1-4-3)

This course deals with the services of the built environment and the community. Topics include the nature of light; sensitivity of the eye; common terms used in lighting design; laws of illumination; polar curves; lighting schemes; lighting sources; filament lamps, electric discharge lamps and arc lamps; effect of voltage variation; starters; efficiency and costs; Lighting installation; interior lighting design, floodlighting design, and street lighting design. Project in Electrical Drawing for Architectural Plans is included. The course includes the selection of transformers, generators, motors switches, circuit breakers and relays.

Learning Outcomes: This course enables the students to demonstrate the following:

1. An ability to apply electrical engineering design processes to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
2. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Course Objectives: By the end of the course, students will be able to:

- Acquire and apply the necessary skills in electrical services designs.
- Identify the necessary terms in electrical services designs.
- Work as a consultant in the areas of electrical services design.

ELEN 424 Electrical Maintenance and Repair (1-4-3)

Electrical tools and equipment for maintenance and repairs. Maintenance Purpose, types, and procedure. Ground rules of Appliance repair. Troubleshooting small appliances, Electrical safety. Maintenance of plants, Repairs of electrical motor, radio receiver and other major electrical equipment. Case studies from the Electrical Repairs Unit.

Learning Outcomes: This course enables the students to demonstrate the following:

1. An ability to develop and conduct appropriate engineering experiment, analyse, and interpret data, and use engineering judgment to draw conclusions.
2. An ability to identify, formulate, and solve complex electrical engineering problems by applying principles of engineering

Course Objectives: By the end of the course, students will be able to:

- Troubleshoot electrical and electronic appliances.
- Carryout maintenance and repairs of basic electrical and electronic equipment.
- Advice users of electrical appliances on the safety measures.
- Work as a consultant in the areas of electrical services design.

ELEN 498 Capstone Project II (1-6-4)

This is the second part of the two-course sequence senior project. Work continues on the design project begun in ELEN 497 culminating in a final product which incorporates multiple design constraints. Oral presentations and written reports are required.

Learning Outcomes: This course enables students to demonstrate an ability to:

1. Communicate effectively with a range of audiences.
2. Recognize ethical and professional responsibilities in engineering situations and make informed judgments.
3. Function effectively in a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
4. Acquire and apply new knowledge as needed, using appropriate learning strategies.
5. Analyse and design complex electrical and electronic devices.
6. Analyse and design systems containing hardware and software components.

Course Objectives:

- Identify and apply international and national codes and standards for the practice of electrical engineering.
- Work in a team to execute a project.
- Organize knowledge and skills acquired and incorporate multiple design constraints.
- Design, develop and test a product in a team.
- Work in a team to present oral project report.
- Work in a team to present a written project report.

9.5 Research Component – Describe the required research to be carried out.

A capstone project is simply a big and highly extensive academic project that is undertaken by the student as a final task in their academic degree programmes. The capstone is more or less a research project. The student will write a proposal in the area they wish to delve in and they will need to produce high-quality original research. It is also in the form of a practical project.

Capstone ventures are commonly intended to urge undergraduates to think fundamentally, take care of testing issues, and create aptitudes, for example, oral correspondence, open talking, examine abilities, media proficiency, cooperation, arranging, independence, or objective setting—i.e., abilities that will help set them up for school, present-day professions, and grown-up life. By and large, the activities are likewise interdisciplinary, as they are expected to examine issues across a wide range of branches of knowledge or areas of information.

There is no research component but rather a Capstone Design Project component. A Capstone Design Project is required for the programme. The Capstone Project component is a major engineering design experience that (1) incorporates appropriate engineering standards and multiple constraints, and (2) is based on the knowledge and skills acquired in earlier course work. Students will undertake a comprehensive capstone project in the Final Year spanning two-semesters. The project will be performed in teams with industry collaboration and support. A project-team will be guided by an academic supervisor, but the team will have a sole responsibility for its performance. The team will be responsible for the planning and execution of the project. Each team must demonstrate understanding of the engineering design process from the identification of a need to product realization.

9.6 Practical training – Internship, clinical experience, externship, etc. should be stated for relevant courses.

Industry Practical Training is a required component of the programme. Table 17 provides the requirements. All students must satisfactorily complete a minimum of twenty-four (24) weeks of industry attachment during the programme. Students will be assigned to industries for 6 weeks at the end of first year, 8 weeks at the end of the second year and 10 weeks at the end of the third year. Students shall present an industrial attachment report that details the student's engagement during the internship and the industry supervisor's assessment. Students must receive "Satisfactory (S)" grade for each internship period. Additional internship weeks may be required of a student who receives an "Unsatisfactory (U)" grade.

Table 17. Internship Requirements

No	Internship	No. of Weeks	Student Requirement	Internship Grade
1	First Internship	6	Written Report and Industry assessment	Satisfactory (S)/Unsatisfactory(U)
2	Second Internship	8	Written Report and Industry assessment	Satisfactory (S)/Unsatisfactory(U)
3	Third Internship	10	Written Report and Industry assessment	Satisfactory (S)/Unsatisfactory(U)

10.0 Requirements for progression and graduation – Give requirements for progression to the next level and the requirements for graduation.

10.1 Progression Requirements

The programme has been designed for the courses to build on each other from year-to-year. The following progression requirements will be enforced to ensure that the student benefits fully from the academic experience.

1. A student must pass each course with a minimum grade of "D" each semester.
2. A student must earn a minimum GPA of 1.0 each semester.
3. If a student does not pass a course with a minimum grade of "D" he/she is required to attend a 2-week review course at the end of the academic year and pass a supplementary examination. The fee for this supplementary review and the examination is determined by the University. The score for the course will be the average of the two marks and will not exceed 55%.
4. A student is in good standing if he/she has a cumulative average score of at least 50% at the end of the academic year. A student who is NOT in good standing does not qualify for scholarships or any financial assistance from the University.

10.2 Graduation Requirements

The following requirements must be met for a candidate to receive the BSc degree:

1. Successfully satisfy all the General Education, Basic Science and Mathematics, Engineering Topics, Entrepreneurship, and Internship Requirements of the Programme.
2. Earn a minimum of 136 credit hours.
3. Successfully defend the Capstone Project.
4. Pass each subject with a minimum score of 45%.
5. Earn a minimum Cumulative GPA of 2.0.

11.0 Employability of graduates – Give possibility of employability of students after graduation

Electrical engineers are employed in a variety of industries, such as: aerospace, automotive, chemical, construction, defense, electronics, consumer goods, marine, materials and metals, pharmaceuticals, rail,

and utilities. Electrical engineers also work in non-engineering types of jobs, both within and outside of the engineering industry. These can be in areas such as finance, management, law, the military, government, medicine, research, technical sales, and technical consulting.

The Electrical Engineering Programme consists of the development of the students' background knowledge in mathematics and basic sciences, and engineering fundamentals and skills culminating in the major areas of concentration. The programme provides student with a broad knowledge in the following areas:

(1) Electrical Power Engineering
(2) Telecommunication Engineering
(3) Electronics Engineering

Students will be provided the necessary knowledge and the practical skills in each category. It is expected that the industry/employer will further develop the graduate in the appropriate area of practice.

12.0 Physical resources (classrooms, workshops, laboratories, etc) – Describe the facilities in which the programme will be offered.

12.1 Classrooms

The Electrical Engineering programme is currently being run at the Kanifing Campus of the University while awaiting the completion of the facilities of USET at the Brikama Campus. The programme resides at the "D" Block at the Kanifing Campus with three dedicated classrooms and one interdisciplinary common classroom. Each classroom is fitted with sufficient writing tables for students, student group tables, a Smart Board, a White Board and a projection system.

12.2 Classroom Equipment and Resources.

The classroom equipment includes student group study tables, Microsoft 365 Educational premium package, Ultra HD Conference Cameras, Wireless microphone sets, Web hosting and setup and DLP Projectors. Information on these resources are provided in the Table 18 below.

Table 18. Available Classroom Resources

ITEM	SPECIFICATION
PROJECTOR	• **Resolution:** 1920x1200 3LCD • **Brightness:** 5000 ANSI Lumens • **Light Source:** Laser • **Throw Distance:** 2.7 m — 4.0 m • **Image Size:**254cm •
COMPUTER	I7 processor with quard core , 8 logical processors HDD 1TB + /SSD 500 RAM 8GB + 8Generation
CAMERA	• 1080p HD video resolution • 90-degree field of view • 4x digital zoom • Right Light 2 Technology for a sharp video even in low-light conditions • Uvc H.264 Encoding for a smooth video stream

SPEAKERS	System Type	2 x 6.5inch, 2-way speaker
	Frequency Response	80Hz -- 20 KHz ± 3dB
	Sensitivity (1W/1M)	96dB.
	Impedance	16 ohms
	Rated Power	120W (RMS), 240W (PEAK).
	Dispersion	90° (H) X 70° (V)
	Drivers	LF driver 2 x 6.5' ' transducer (50mm) voice coil
		HF driver 1' ' exit (34mm) voice coil.
	Maximum SPL	116dB
	Connectors	2 x Neutrik NL4.
	Dimensions	(W) 180mm x (H) 540mm x (D) 215mm
SOFTWARE	• Zoom for reliable, large video calls • Google Meet for G Suite users • GoToMeeting for professional features • join.me for a lightweight option • Webex for whiteboarding	
MICROPHONE	• Support Mode: Limit (1/2/3/4), FIFO (1/2/3/4) • Microphones can be operated on either their built-in rechargeable batteries • Wireless communication system • Operation distance up to 100 meters with the best condition • Builtin feedback eliminating technology which can decrease the fee dback and noise effectively • Built-in multiple noise detecting circuit and TONE-LOCK system to make sure the system has strong anti-jamming function	

12.3 Laboratory Equipment and Shops

The Electrical/Electronic
Engineering Programme is supported by eight (8) laboratories. The Laboratories include Electric Circuit Analysis Lab, Electric Machines Lab, Linear Control Systems Lab, Power Electronics Lab, Synchronous Machines Lab (Drives Lab), Power Systems Operations Lab, Power Generation Lab, Signal Processing Lab.

The items in each laboratory are listed in the Table 19 below.

Table 19. Electrical Engineering Laboratories and Shop Equipment

USET ELECTRICAL LAB EQUIPMENT LIST		
NO	SPECIFICATION	QUANTITY
A.	**ELECTRICAL MACHINE LABORATORY**	
1.	D.C. Motor 230V AC, 16.8A	2
2.	Three Phase Induction Motor 400 V DC, 4.75 A	2
3.	Three Phase Transformer (2Nos.) 400/230V Y connected 10A	2

4.	Single Phase Transformer (2Nos.) 220/110V AC, 13.62/27.25 A	1
5.	Single Phase Transformer (6 Nos) 230/115V AC 13.2/26.1A	1
6.	DC Motor – 1HP	2
7.	DC Motor – 3HP	2
8.	DC Motor & Generator Set (4 Nos.) 230V DC 13A, 230V AC 20.5A	2
9.	Three Phase Induction Motor Amplidyne Set 400V AC	1
10.	DC Motor and DC Series Generator Set 230 V 19.3 A, 230 V 23A	1
11.	Charger and DC Generator Set 2.4 KVA, 230 /400V, 12/7A, 4 KW 220 V 21.8A	1
12.	Three Phase Induction Motor and DC Generator Set 2.2KW, 1.6KW	1
13.	DC Motor and single Phase Alternator 230V 20A, 230 V 13A	2
14.	DC Motor and 3 Phase Alternator 230 19.3A, 230/400 V Delta/Star 7.5/14.35A	2
15.	Three Phase Induction Motor 400 VAC 4.95A	2
16.	DC Series Motor and Series Generator 2.3 KW	1
17.	Single Phase Induction Motor and DC Generator Set 3 KW, 5 BHP	1
18.	Regulated DC power supply, 250v, 60A (01 unit)	5
B.	**CONTROL SYSTEM LAB.**	
1.	Digital storage Oscilloscope (DSO)	2
2.	Magnetic Levitation System	2
3.	Servomotor Control and Instrumentation	1
4.	Twin Rotor Mimeo System	1
5.	Nio Robot	1
6.	Nao Robot	1
C.	**POWER SYSTEM LABORATORY**	
1.	AC Generator protection Panel, equip/08/06-07	1
2.	Relay Testing kit	2
3.	Static Var Compensator	1
4.	Artificial Transmission Line A B C D	1
5.	DC network analyser, equip/61/04-05 & determination of ABCD parameter, equip/61/04-05	1
6.	Adaptive power factor controller, equip/61/04-05	1
7.	Numerical Relay	2
8.	Air circuit breaker (Digital Trip Relay) & Accessories	3
9.	Scada based Electric Power Transmission System	1
D	**POWER ELECTRONICS LABORATORY**	
1.	High Voltage Pro	5
2.	Current probe 100a ac/dc; Tektronix	5
3.	Digital Power Meter; WT 230	2
4.	Agilent DSO 100MH 2 Chanel Oscilloscope	1
5.	Voltage Probe; Agilent 1007, 100:1, 250MHZ HIGH	5

6.	JTAG Emulator for Interfacing the DSP, XDSS510PP	2
7.	Three Phase Power Quality Analyzer, Fluke 434	1
8.	Arbitrary Function Generator AFG 3102	1
9.	Programmable Power Supplies Agilent-6030A	2
10.	4-CH DSO, Tektronix – TPS2024	1
11.	2-Channel, 10 MHZ Function Generator 33210A	1
12.	Passive Current probe Tektronix	5
13.	Electric Vehicle: Fuel: Electric, Gear Box: Automatic, Motor: 3000W, Max voltage:≥60, Max speed:≥42, Multi Media: Mp5 +Rearview Camera, Battery: Lithium Battery	1
E	**SYNCHRONOUS MACHINES LAB (DRIVES LAB)**	
1.	3-Phase IGBT Based PWM Inverter	2
2.	AC Machine 3 PHASE – 1HP	1
3.	AC Machine 3 PHASE – 3HP	1
4.	DC Machine – 1HP	1
5.	DC Machine – 3HP	1
6.	Primer Spartan 3 Development Kit with interface card	5
7.	Universal Development Board with interface card	5
8.	AD 0809 Interface Card	4
9.	FPGA Based Speed Control of BLDC Drive	2
10.	Speed Control Synchronous (PMSM) Motor Coupled with DC Generator setup	2
11.	Speed Control of 3 Phase Wound Rotor Induction Motor with DC Generator setup	2
F	**ELECTRICAL MEASUREMENT & INSTRUMENTATION LABORATORY**	
1.	LVDT Kit	5
2.	Strain Gauge Kit	5
3.	Photo Transducers Kit	5
4.	Optical Transducer Kit	5
5.	CRO Trainer	5
6.	Kelvin's Double Bridge	5
7.	Digital Storage Oscilloscope D36060CA (APLAB)	1
8.	LCR Q Meter 4910 (APLAB)	2
9.	Digilent NI MYRIO Mechatronics Kit	5
10.	Digital Gauge Meter, Model No. - D20AC	2
11.	Decade Capacitance BOX, MODEL NO. - 709 (NAVIS)	2
12.	Function Generator 25 MHZ, 2 Channels, Model NO. - 416	2
G	**EEM LAB**	
1.	3phase Auto Transformer 415/415-470,15amp,15.P.3	1
2.	3phase Resistive Load Box 1A×4, .5×2	1
3.	Measurement of Displacement using LVDT Input 220 V AC	1
4.	Measurement & control of Temp. Using Thermocouple Input 220 V AC	1
5.	Torque measurement Trainer Input 220 V AC	1
6.	Measurement of Strain using Strain Gauge Input 220 V AC	1

7.	Pressure Measurement Module Input 220 V AC	1
8.	Capacitive Pickup trainer	5
9.	Regulated DC power Supply 0-5V, 0-10 A	2
10.	Schering Bridge Input 220 V AC	2
11.	Kelvin's Double Bridge Input 220 V A C	2
12.	Anderson Bridge For self-inductance	2
13.	Decade capacitive box	2
14.	Portable Wheatstone bridge	2
15.	Deflection galvanometer Cat no. pl64	2
16.	Spectrum analyzer	1
17.	Synchro scope	1
18.	1 Auto Transformer	1
19.	1 Load box ,1 KW, 4 AMP,230V, 1 Load box 3 KW, 12 AMP,230V	1
H	**MACHINE & BEE LAB**	
1.	Main AC Incoming Panel, Voltage – 415 V 3-Phase, 50 Hz Amps – 100 A Rating – CMR	1
2.	AC Distribution Panel Volts– 415V, 3 Phase, 50 Hz.	1
3.	Current Transformer 5:1WPL, 5VAMP, 66KV	1
4.	Potential Transformer 230/110V, 66KV	1
5.	Resistance Temperature Display 230V, 50HZ	1
6.	AC AMMETER, 0 – 10 AMP	5
7.	AC VOLTMETER, 0 – 600 VOLT	5
8.	AC VOLTMETER 0 – 300 VOLT	5
9.	WATTMETER, 0 – 600 V, 1200W	5
10.	WATTMETER, 0 – 300 V, 300W, 10A	5
11.	WATTMETER 0 – 230 V, 1200W	5
12.	ENERGYMETER 1 phase two wire, 240v, 50 Hz	2
13.	MULTIMETER, 0-1000V AC Amps – 100 A Rating – CMR	2
DIDACTIC TRAINING EQUIPMENT		
1.	MR401E Lamps for Photovoltaic Solar Trainers	1
2.	Electrical Training Panel Educational Equipment Electrical Installation Lab Didactic Equipment	1
3.	Flat Panel Solar Energy	1
4.	PLC Vocational Training Equipment Didactic Electrical Automatic Trainer	1
5.	PLC Universal Application Simulator	1
6.	Testing Modules for Lighting	1
7.	Electronics Training Workbench Variable Frequency Drive Training Systems Didactic Equipment	1

13.0 Teaching and learning resources

13.1 Textbook and Reading Materials

Table 20 below provides a list of textbooks, reading and reference materials for each course. Most of these are available online for downloading, purchase or borrowing from e-libraries.

Table 20. List of Textbooks and Recommended Readings

No	Course No.	Course Title	Textbook
1	ELEN 121	Introduction to Electrical Engineering	Fundamentals of Electrical Engineering, Giorgio Rizzoni, McGraw-Hill, 2nd Edition, 2021 Engineering Fundamentals and Problem Solving, Arvid Eide and Steven Mickelson and Roland Jenison and Larry Northup, McGraw-Jill, 8th Edition, 2022
2	ELEN 112	Electrical Shop Practices	Principles and Applications of Electrical Engineering, Giorgio Rizzoni and James Kearns, McGraw-Hill, 7th Edition, 2021
3	ENGL 102	Technical Report Writing	Technical Writing for Engineers & Scientists, Leo Finkelstein and Jeanine Elise Aune and Leslie A. Potter McGraw-Hill, 4th Edition, 2022
4	CHEM 101/102	Applied Chemistry/Lab	Chemistry: The Molecular Nature of Matter and Change, Martin Silberberg and Patricia Amateis, McGraw-Hill, 9th Edition, 2020
5	ENGR 103	Introduction to Entrepreneurship	Instructor's Notes and Handouts
6	ENGR 113	Engineering Graphics	Blueprint Reading, Sam Kubba, McGraw-Hill, 1st Edition, 2008
7	PHYS 102/112	Applied Physics	Physics, Alan Giambattista, McGraw-Hill, 5th Edition, 2019
8	ELEN 114	Electrical Engineering Graphics	Electrical Engineering Drawing, S. K. Bhattacharya, New Age International, 2nd ed, 2005
9	ENGR 102	Fundamentals of Materials Science	Foundations of Materials Science and Engineering, William Smith and Javad Hashemi, McGraw-Hill, 7th Edition, 2022
10	MATH 101	Calculus I	Calculus, Robert T Smith and Roland Minton, McGraw-Hill, 4th Edition, 2011
11	MATH 102	Calculus II	Calculus, Robert T Smith and Roland Minton, McGraw-Hill, 4th Edition, 2011
12	ENGL 101	English Communication	English Language & Communication Skills, Michael Denison-George, 2020
13	ENGL 102	Technical Report Writing	Technical Writing for Engineers & Scientists, Leo Finkelstein and Jeanine Elise Aune and Leslie A. Potter McGraw-Hill, 4th Edition, 2022
14	ENGR 111	Introduction to ICT	Introduction to Information & Communications Technology, NOTES
15	ENGR 116	Introduction to Innovation Projects	Customer Integration in Industrial Innovation Projects, Patricia Sandmeier, Springer Fachmedien Wiesbaden, 2008
16	SOCI 201	Principles of Sociology	Essential Concepts in Sociology, Philip W. Sutton and Anthony Giddens Wiley, 3rd Edition, 2021
17	MATH 221	Numerical Methods	Applied Numerical Methods with Python for Engineers and Scientists, Steven Chapra and David Clough, McGraw-Hill, 1st Edition, 2021 Numerical Methods for Engineers, Steven Chapra and Raymond Canale, McGraw-Hill, 8th Edition, 2020

			Applied Numerical Methods with MATLAB for Engineers and Scientists, Steven Chapra, McGraw-Hill, 5th Edition, 2022 MATLAB for Engineering Applications, William Palm, McGraw-Hill, 4th Edition, 2018
18	MEEN 204	Fundamentals of Thermodynamics	Thermodynamics: An Engineering Approach, Yunus Cengel and Michael Boles, McGraw-Hill, 9th Edition, 2018
19	ELEN 221	Programming in C	The C Programming Language, Second Edition by Brian W. Kernighan and Dennis M. Ritchie. Prentice Hall, Inc., 1988.
20	PHYS 201/211	Applied Physics	Physics, Alan Giambattista, McGraw-Hill, 5th Edition, 2019
21	MATH 201	Mathematical Analysis	Applied Mathematics for Science and Engineering Larry A. Glasgow, 2014
22	MEEN 201	Engineering Mechanics - Statics	Engineering Mechanics: Statics, Michael Plesha and Gary Gray, McGraw-Hill, 3rd edition, 2022 Vector Mechanics for Engineers: Statics, F. Beer and E. Johnson, etc. McGraw-Hill, 12th edition, 2019
23	ENGR 201	Enterprise Development	Instructor's Notes + Handouts
24	ENGR 212	Intermediate Innovation Project I	Strategic Management of Technological Innovation, Melissa Schilling, McGraw-Hill, 6th Edition, 2019
25	MEEN 202	Engineering Mechanics – Dynamics	Engineering Mechanics: Dynamics, Michael Plesha and Gary Gray, McGraw-Hill, 3rd edition, 2022 Vector Mechanics for Engineers: Dynamics, F. Beer and E. Johnson, etc. McGraw-Hill, 12th edition, 2019
26	ELEN 222	Electrical Engineering Materials	Foundations of Materials Science and Engineering, William Smith and Javad Hashemi, McGraw-Hill, 7th Edition, 2022 Principles of Electronic Materials and Devices, Safa Kasap, McGraw-Hill, 4th Edition, 2017 Fundamentals of Semiconductor Devices, Betty Anderson and Richard Anderson, McGraw-Hill, 2nd Edition, 2017
27	ELEN 204/214	Electric Circuit Analysis	Engineering Circuit Analysis, William Hayt and Jack Kemmerly and Jamie Phillips and Steven Durbin, McGraw-Hill, 10th Edition, 2023
28	MATH 202	Differential Equations	Differential Equations with MATLAB, Brian R. Hunt, Ronald L. Lipsman, John E. Osborn, Jonathan M. Rosenberg, 2012
29	PSYC 202	Principles of Psychology	Introduction to Psychology, University of Minnesota Library Publishing Edition, 2015
30	MATH 303	Engineering Statistics	Statistics for Engineers and Scientists, William Navidi, McGraw-Hill, 6th Edition, 2023
31	ELEN 302/312	Electric Machines	Fitzgerald & Kingsley's Electric Machinery, Stephen Umans, McGraw-Hill, 7th Edition, 2013
32	ELEN 307	Control Engineering	1. K. Ogata, "Modern Control Engineering", 4 th Edition, PHI. 2. I. J. Nagrath and M. Gopal, "Control System Engineering", 4 th Edition, New Age.

33	ENGR 301	STEM Entrepreneurship	Customer Integration in Industrial Innovation Projects, Patricia Sandmeier, Springer Fachmedien Wiesbaden, 2008
34	ECON 301	Principles of Microeconomics	Microeconomics, David Besanko, Ronald Braeutigam, Wiley, 6th Edition, 2020
35	ECON 302	Engineering Economic Analysis	Engineering Economy, Leland Blank and Anthony Tarquin, McGraw-Hill, 9th Edition, 2023
36	ELEN 303	Digital Systems and Networks	Digital Electronics: Principles and Applications, Roger Tokheim and Patrick Hoppe, McGraw-Hill, 9th Edition, 2021
37	ELEN 305	Electromagnetics	Electromagnetic Fields and Waves: Fundamentals of Engineering, Sedki Riad and Iman Salama, McGraw-Hill, 1st Edition, 2019 Engineering Electromagnetics, William Hayt and John Buck, McGraw-Hill, 9th Edition, 2018
38	ELEN 317	Control Systems Lab	Programmable Logic Controllers, Frank Petruzella, McGraw-Hill,6th Edition, 2022 Electric Motors and Control Systems, Frank Petruzella, McGraw-Hill, 3rd Edition, 2019
39	ENGR 316	Intermediate Innovation Project II	Strategic Management of Technological Innovation, Melissa Schilling, McGraw-Hill, 6th Edition, 2019
40	ELEN 304/314	Power Electronics	Power Electronics, Daniel Hart , McGraw-Hill, 1st Edition, 2010
41	ELEN 309	Circuit Theory	Engineering Circuit Analysis, William Hayt and Jack Kemmerly and Jamie Phillips and Steven Durbin, McGraw-Hill, 10th Edition, 2023 Microelectronics Circuit Analysis and Design, Donald Neamen, McGraw-Hill, 4th Edition, 2009 Microelectronic Circuit Design, Richard Jaeger and Travis Blalock, McGraw-Hill, 5th Edition, 2015
42	ELEN 306	Communication Systems	Data Communications and Networking with TCP/IP Protocol Suite, Behrouz A. Forouzan, McGraw-Hill, 6th Edition, 2021 Communication Systems, A. Bruce Carlson and Paul Crilly, McGraw-Hill, 5th Edition, 2009.
43	ELEN 326	Electrical Measurements and Instrumentation	Introduction to Instrumentation and Measurements, Robert B. Northrop, Taylor and Francis, 2nd ed., 2005
44	ELEN 401/411	Electric Machines	Fitzgerald & Kingsley's Electric Machinery, Stephen Umans, McGraw-Hill, 7th Edition, 2013
45	ELEN 402	Digital Signal Processing	Digital Signal Processing, Steven W. Smith, California Technical Publishing, 2nd edition, 1999 Essential Guide to Digital Processing, Richard Lyons and D. Lee Fugal, Pearson, 2014
46	ELEN 403/413	Power System Operation and Control	Power System Analysis, John Grainger and William Stevenson, McGraw-Hill, 1st Edition, 1994
47	ELEN 405/415	Power Generation and Supply	Smart Grid Infrastructure & Networking, Krzysztof Iniewski, McGraw-Hill, 1st Edition, 2012

48	ELEN 422	Electrical Services Design	Foundations of Engineering, Mark Holtzapple and W. Reece, McGraw-Hill, 3rd Edition, 2022 Electricity for the Trades, Frank Petruzella, McGraw-Hill, 3rd Edition, 2019
49	ELEN 424	Electrical Maintenance and Repair	How to Diagnose and Fix Everything Electronic, Michael Geier, McGraw-Hill, 2nd Edition, 2015 Troubleshooting and Repairing Major Appliances, Eric Kleinert, McGraw-Hill, 3rd Edition, 2012
50	ENGR 423	Entrepreneurship Project	Customer Integration in Industrial Innovation Projects, Patricia Sandmeier, Springer Fachmedien Wiesbaden, 2008
51	ELEN 497/498	Electrical Capstone Project	Practical Electronics for Inventors, Fourth Edition, Paul Scherz and Simon Monk, McGraw-Hill, 4th Edition, 2016

13.2 Required teaching aids/materials

Teaching aids are strongly encouraged and provided per the subject area. Typical electronic devices such as ammeters, voltmeters, wattmeters, multimeters are readily available for demonstration. Also available are electric motors and generators. The didactics training equipment consist of a series of teaching aids such as Lamps for Photovoltaic Solar Trainers, Electrical Training Panel Educational Equipment, Electrical Installation Lab Didactic Equipment, Solar Energy Panels, PLC Vocational Training Equipment Didactic Electrical Automatic Trainer, PLC Universal Application Simulator Testing Modules for Lighting and Electronics Training Workbench Variable Frequency Drive Training Systems Didactic Equipment

14.0 Provisions made for physically challenged staff and students. Describe clearly provisions made to ensure that the physically challenged staff and students can effectively participate in the programme.

The Electrical Engineering programme is currently being run at the Kanifing Campus of the University while awaiting the completion of the facilities of USET at the Brikama Campus. The programme resides at the "D" Block at the Kanifing Campus with three dedicated classrooms and one interdisciplinary common classroom. The "D" Block has two levels. A handicap ramp is provided between the floors. The facility at Brikama has three levels. A lift connecting all floors is provided for the handicapped. Additionally, a ramp is provided between the first and second floors to serve the physically challenged in case the lift is not operable.

15.0 Curriculum Activities – Describe how the curriculum will be deployed. This will include but not limited to the instructional method for the programme, teaching method and planned technology.

Method of Instruction is Face-to-Face. However virtual sessions may be allowed when necessary.
Lecture Contact Hours = 93 Hours
Laboratory and Practical Hours = 86 Hours
Total Contact Hours = 179 Hours
Total Credit Hours = 136 Hours

16.0 Assessment Criteria – State how the students will be assessed for each course.

Individual subjects are assessed through examinations, assignments, laboratory work and practical exercises. Project and design works are assessed through written and oral examination by a panel of examiners. Work experience through vacation training (industrial attachment) in industry forms an integral part of the undergraduate programme. A formal industrial assessment report is submitted by the student to the department and assessed by assigned lecturers. Additionally, the student must submit to the department an industrial attachment assessment by the industry supervisor.

Examinations will be conducted in accordance with regulations approved from time to time by the University Senate. To sit for any end of course examination, candidates must be duly registered for the course, and attain 75%-point attendance at the course lectures/laboratory, practical/tutorials. Students who are absent from lecture/laboratories/tutorials must communicate their reason to their course lecturers. Every course shall be examined during the academic semester during which it is taken. End of course examination assessment will consist of the following:

Continuous assessment – 40%
Written Final Examination – 60%

Examinations and continuous assessments of laboratory and workshop practice courses may take the form of workshop/laboratory practical, open book and take-home exams, oral presentations, fabricated products assessment, and written exams. Assessment of laboratory/workshop practice course shall consist of:

Continuous assessment - 60%
Written final examination – 40%.

17.0 Grading system – Give the grading system to be used throughout the programme.

17.1 Letter Grades

The scores achieved in each course will be assigned a Letter Grade as shown in Table 21 and a corresponding Grade Point (GP). The following letters and grade points shall be attached to the scores (rounded). The minimum pass mark for each course is 45% with a grade of "D".

Table 21. Grading Scheme

SCORE (%)	LETTER GRADE	GRADE POINT
75 – 100	A	4.0
70 – 74	B^+	3.5
65 – 69	B	3.0
60 – 64	C^+	2.5
55 – 59	C	2.0
50 – 54	D^+	1.5
45 – 49	D	1.0
Below 45	F	0.0

17.2 Grade Point Average (GPA) and Cumulative Grade Point Average (CGPA)

For each semester of study, the Grade Point Average (GPA) and the Cumulative Grade Point Average (CGPA) of a student shall be calculated. Any student whose CGPA is less than 1.0 in any one academic year is placed on PROBATION for the following academic year. If the CGPA is still less than 1.0 at the end of two consecutive years, then the student shall be withdrawn from the programme.

The Semester Grade Point Average (GPA) is computed by dividing the total sum of the product of the grade point and the number of credit hours by the total available credit hours for the semester. The Cumulative Grade Point

Average (CGPA) is computed by dividing the cumulative sum of the product of the grade point and the number of credit hours by the total available credit hours for the total number of credit hours.

17.3 Class of Degree

The class of degree shall be awarded on the basis of the final CGPA as follows:

3.50 - 4.00	-	First Class Honours
3.25 - 3.49	-	Second Class Upper Division Honours
3.00 – 3.24	-	Second Class Lower Division Honours
2.50 - 2.99	-	Third Class
2.00 – 2.49	-	Pass

The Final Class of Degree will appear on the graduate's Certificate.

18.0 Staffing

The programme currently has adequate staff members to handle all the courses in the first two years. The academic staff fall into the following categories:

1. *Full Time Staff.* These staff members have the necessary academic qualifications with at least Master's Degree and currently hold academic positions at USET. The typical full time staff member has teaching responsibilities with both the Institute of Technical Training or the Institute of Innovation and Entrepreneurship and the College of Science and Engineering. Teaching Loads for such staff members are assessed to avoid overloading and remunerated if his/her loads exceed the maximum required by the University.

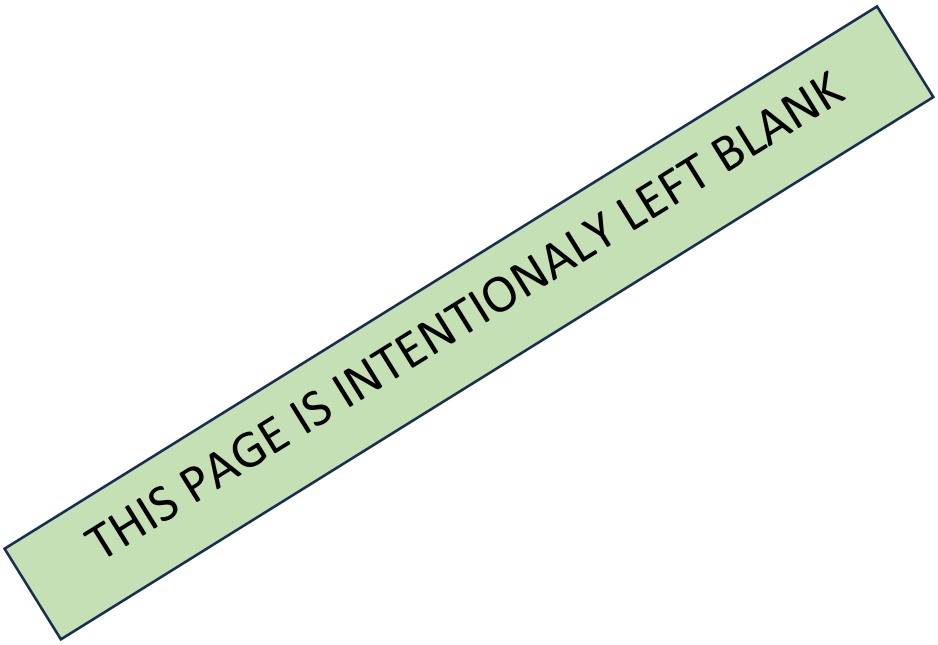
2. *Adjunct Part Time Lecturer:* These staff members have the necessary academic qualifications with at least Master's Degree and currently hold academic positions elsewhere. Such staff members are remunerated and assigned no more than two courses in the same semester.

The Table 22 below provides a list of lecturers involved for the programme**.**

No	Full Name	Sex M/F	Status FT/PT	Rank	Qualification (starting from highest indicating title of programme, institution of award, year of award and place)	Area of specialization	Courses Taught	Teaching Experience
1	Cajethan M. Nwosu	M	FT	Full Professor	PhD Electrical Engineering	Power Devices, Electric Drives and Renewable Energy Systems	Control Engineering, Circuit Theories, Electric Services Design, Power Electronics, Introduction to Electrical Engineering, Electric Circuit Analysis, Power System Operation and Control	23 years
2	Isatou Dibba	F	PT	Adjunct Lecturer	MSc - Electronics	Electronics	Introduction to EE; Electrical/Electronic Circuits	4 years
3	Sulayman Kujabi	M	FT	Principal Lecturer (On Study Leave)	MPhil (Electrical/Electronic); PhD in Progress	Electronics	Circuit Theories, Electric Services Design, Power Electronics	13 years
4	Amadou Baldeh	M	FT	Principal Lecturer	MPhil (Electrical/Electronic);	Power Systems	Control Engineering, Circuit	27 years

				(On Study Leave)	PhD in Progress		Theories, Electric Services Design, Power Electronics, Introduction to Electrical Engineering, Electric Circuit Analysis, Power System Operation and Control	
5	James J. Gomez	M	FT	Lecturer (On Study Leave)	MPhil (Electrical/Electronic); PhD in Progress	Power Systems	Intro to EEE, Electrical Graphics, Electrical Workshop, Power Generation and Supply, Electrical Maintenance and Repair, Electrical Services Design	19 years
6	Binta Sanyang	F	FT	Lecturer (On Study Leave)	MS (Telecom), PhD in Progress	Signal Processing	Introduction to ICT, Control Systems/Lab, Digital Systems and Networking, Digital Signal Processing/Lab	17 years
7	Gbemileke Solomon Ayedun	M	PT	Adjunct Lecturer	MSc	Industrial Chemistry	Chemistry; Materials Science	5 years

8	Musa FM Danso	M	PT	Adjunct Lecturer	MA	English Language	English Communication; Technical Report Writing	12 years
9	Alhagie Hydara	M	FT	Lecturer	MSc – Mathematical Sciences	Mathematical Sciences	Calculus; Mathematics	6 years
10	Ballu Christopher Junior	M	FT	Lecturer	MSc; Government Technical Institute, SierraLeone, 2021	Civil Engineering	Engineering Graphics, Introduction to Engineering	5 years
11	Ikonne Ozioma	M	FT	Senior Lecturer	PhD – Business and Entrepreneurship	Innovation and Entrepreneurship	Entrepreneurship	6 years
12	Gaston Mendy	M	FT	Lecturer	MSc – Computer Science	Computer Science	ICT, Computer Graphics	18 years
13	Silfat A. Jubril Sanni	F	FT	Lecturer	MSc – Management Information Systems	Management Information Systems	ICT, Engineering Graphics	2 years
14	Mbye Sowe	M	PT	Adjunct Lecturer	MSc – Electrical Engineering	Electrical Engineering	Electrical/Electronic Circuits	2 years
15	UTO, Oghenekevwe Timothy	M	PT	Adjunct Lecturer	PhD; Federal University of Agriculture, Nigeria, 2012	Physics	Physics	4 years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